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EXAMINER	
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ART UNIT	**PAPER NUMBER**
2621	

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Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)
	08/464,034	HYATT, GILBERT P.
	Examiner	Art Unit
	Brian P. Werner	2621

-- *The MAILING DATE of this communication appears on the cover sheet with the correspondence address* --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *see action paragraph 1*.

2a)☒ This action is **FINAL**. 2b)☐ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *see action paragraph 1* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *all pending* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☒ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date *attached*.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: _____.

DETAILED ACTION

1. This Office Action is responsive to the following submissions:

- The claim amendment and arguments received on November 3, 2004;
- The specification and drawing amendment received on June 29, 2004. The new drawings (Figures 10-13) are approved. The specification amendment adding references to these drawings to the specification is also approved.

The currently pending claims are as presented in the November 3, 2004 amendment.

Information Disclosure Statement

2. The information disclosure statement(s) attached hereto have been considered, and singed/initialed copies are provided herewith. Non-patent literature documents marked with "NC" and "NA" were not considered because they were not provided with the IDS.

Claim Rejections - 35 USC § 112

3. The following is a quotation of the first paragraph of 35 U.S.C. 112:

> The specification shall contain a written description of the invention, and of the manner and process of making and using it, in such full, clear, concise, and exact terms as to enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to make and use the same and shall set forth the best mode contemplated by the inventor of carrying out his invention.

Written Description

4. All pending claims continue to be rejected under 35 U.S.C. 112, first paragraph, as failing to comply with the written description requirement. The claim(s) contains subject matter which was not described in the specification in such a way as to reasonably convey to one skilled in the relevant art that the inventor(s), at the time the application was filed, had possession of the claimed invention.

The written description rejection advanced in the previous Office Action is incorporated herein by reference. In the rejection, claim 554 was held as an example of unsupported subject matter. While this claim has been amended, the same written description rejection advanced in the previous Office Action applies.

In section I of the applicant's response (addressed below), arguments are presented with respect to the alleged disclosure of a "self-contained embodiment". The applicant appears to be relying upon obviousness. The clarified written description rejection below is a direct response to these arguments. This clarification does not represent a shift in position, nor does it represent a new ground of rejection. It is merely a constructive response to the amendment and to the arguments.

The aforementioned currently pending claims are all rejected under 35 U.S.C. 112, first paragraph, as failing to comply with the written description requirement. The claim(s) contain subject matter that was not described in the specification in such a way as to reasonably convey to one skilled in the relevant art that the inventor(s), at the time the application was filed, had possession of the claimed invention. An explanation shall follow.

Legal Basis

The legal criteria for the "written description" requirement is laid out in MPEP chapter 2163, The Written Description Requirement, as well as the Guidelines for Examiner of Patent Applications Under the 35 U.S.C. 112, ¶1, "Written Description" Requirement, published in the Federal Register, Vol. 66. No. 4, Friday, January 5, 2001 (referred to herein as the "Guidelines"). The examiner has adhered to both the MPEP and the Guidelines, as well as governing case law.

The original disclosure, comprising the originally filed specification, claims and drawings, is the sole basis for the written description support of claimed subject matter. "Application sufficiency under §112, first paragraph, must be judged as of the filing date [of the application]." *Vas-Cath*, 935 F.2d at 1566, 19 USPQ2d at 1119 (citing *United States Steel Corp. v. Phillips Petroleum Co.*, 865 F.2d 1247, 1251, 9 USPQ2d 1461, 1464 (Fed. Cir. 1989)). "[T]he test for sufficiency of support ... is whether the disclosure of the application relied upon 'reasonably conveys to the artisan that the inventor had possession at that time of the later claimed subject matter.'" *Ralston Purina Co. v. Far-Mar-Co., Inc.*, 772 F.2d 1570, 1575, 227 USPQ 177, 179 (Fed. Cir. 1985) (quoting *In re Kaslow*, 707 F.2d 1366, 1375, 217 USPQ 1089, 1096 (Fed. Cir. 1983)). "'Although [the applicant] does not have to describe exactly the subject

matter claimed, . . . the description must clearly allow persons of ordinary skill in the art to recognize that [he or she] invented what is claimed.'" *Id.*, 19 USPQ2d at 1116 (quoting *Gosteli*, 872 F.2d 1008, 1012, 10 USPQ2d 1614, 1618 (Fed. Cir. 1989)). It is "not a question of whether one skilled in the art might be able to construct the patentee's device from the teachings of the disclosure .... Rather, it is a question whether the application necessarily discloses that particular device." (*Jepson v. Coleman*, 314 F. 2d 533, 536, 136 USPQ 647, 649-50 (CCPA 1963)).

Obviousness Cannot Be Relied Upon

In order for a full and complete understanding of the complex issues surrounding written description, one initial point on the written description criteria is noted. In the written description rejection below, the examiner provides a clear explanation of the guiding criteria. In determining whether the claims have a corresponding written description, the specification was read for coherent embodiments, partial embodiments, or some cohesive suggestion or guide that would tie together the disparately disclosed elements of the specification in the manner claimed. Hindsight, or relying upon the claim itself as a guide, is improper.

One additional element to this criteria is noteworthy. That is, written description is analogous to anticipation, not obviousness. The claimed inventions must be anticipated by the original disclosure, not obvious in view of the original disclosure. Given many of the currently pending claims as guides, an argument that one skilled in the art would have found the written description to be obvious is erroneous. ***The main question is whether the applicant actually invented what is now claimed; not whether the applicant invented a system from which the now claimed invention would have been obvious***. It is "not a question of whether one skilled in

the art might be able to construct the patentee's device from the teachings of the disclosure .... Rather, it is a question whether the application necessarily discloses that particular device." (*Jepson v. Coleman*, 314 F. 2d 533, 536, 136 USPQ 647, 649-50 (CCPA 1963)). "The question is not whether a claimed invention is an obvious variant of that which is disclosed in the specification. Rather, a prior art application itself must describe an invention, and do so in sufficient detail that one skilled in the art can clearly conclude that the inventor invented the claimed invention as of the filing date sought" *Lockwood v. American Airlines Inc.* 41 USPQ2d 1961 at 1966 (Fed. Cir. 1997).

Applicant's Disclosed Invention

The disclosed invention appears to be several generalized image processing architectures having numerous optional capabilities. The specification is a description of several optional architectures (e.g., Figures 1A-1D and 1F-1O), each architecture having numerous optional inputs, supervisory functions, geometric processing capabilities, spatial processing capabilities, multiplexing capabilities, and outputs (e.g., the tables at specification pages 24-30 describe many of these options), with miscellaneous descriptions of image processing operations scattered throughout (and not seemingly related to each other). ***The specification lacks coherent embodiments and cohesive descriptions that tie the architecture, hardware options and/or miscellaneous processing descriptions together in a manner that describes the claimed inventions.*** This is the primary basis for the written description rejections advanced herein. Examples of the architecture, hardware options and miscellaneous processing descriptions are provided immediately below.

Some of the optional architectures include (see specification page 5):

- Fig IA is a block diagram representation of one configuration of the system of the present invention)
- Fig IC is a block diagram of a single channel configuration of one configuration of the present invention in accordance with a reduced implementation of Fig IA
- Fig IH is a block diagram of an alternate configuration of the system of the present invention as implemented in an experimental system
- Fig 1I is a block diagram of another alternate configuration of the system of the present invention
- Fig IJ is a block diagram of still another configuration of the system of the present invention
- Fig IL is a block diagram of still another configuration of the system of the present invention
- Fig 1O is a flow diagram showing operation of one geometric processor configuration

A brief review of these figures reveals that the architectures are all different, having different functional blocks and different interconnections. This fact per se is not the issue. Again, the issue is the lack of coherent embodiments and cohesive descriptions that tie one or more of these architectures to the numerous hardware options and miscellaneous processing descriptions discussed below.

The specification describes numerous input devices, processing capabilities, and output devices and described as "capabilities", or "options" of the aforementioned architectures.

Some of the optional inputs include (spec. page 25):

- Winchester disk
- VAX bus interface
- Multi-bus interface
- Video disk
- Video tape
- Vidicon
- Orthocon
- Infrared
- Radar
- Sonar

Some of the optional geometric processing capabilities include (spec. page 26):

- Rotation
- Compression
- Expansion
- Translation

- 3D-Perspective
- Warping

Some of the optional spatial processing capabilities include (spec. page 29):

- Pipeline processing
- Progressive Compression
- Pre-filtering
- Post-filtering

Some of the optional output devices include (spec. page 30):

- Winchester Disk
- Pattern Recognition System
- CRT Monitor
- Video Keyer
- Video Cassette
- Artificial Intelligence System

These (and other) hardware and/or processing capabilities and options are described in brief snippets throughout the specification. For example, specification page 16 states (in part):

> "The image processor can be implemented in a range of configurations, including an image processing subsystem and an image processing system. One configuration is a multiple channel high resolution image processor. Various modules are discussed to accommodate different types of input and output interfaces and multiple channel capability. The various modules of the image processor permit implementation of a basic configuration and then permit modular expansion to a multi-channel system. Modularity permits the basic configuration to be implemented in multitudes of ways using such modules."

The specification describes "configurations" and "modularity". However, it is never clear which architecture is configured with which options to achieve which claimed invention. For another example, specification page 375 states (in part):

> "Compression may be needed to iteratively compress an image with anti-aliasing to overcome undersampling and aliasing that may be caused with the geometric processor processing the image in image memory. Filtering may be needed to reduce the spatial frequencies to overcome aliasing that may be caused with the geometric processor or the preprocessor compressing the image."

Here, like most descriptions of the optional capabilities, "compression" and "filtering" are discussed as something that "may be needed"; and not as part of a coherent embodiment where compression and filtering are actually used together. Also like many of the descriptions, it is not clear which of the plurality of architectures is configured to compress and/or filter the image.

Again, the specification fails to describe any one of the architectures as being specifically configured with a particular set of optional hardware or processing capabilities for performing any particular one of the numerous discloses image processing functions. The specification is a mixing bowl of architectures, options, and miscellaneous image processing functions that lacks coherent embodiments and cohesive descriptions that tie them together; especially in a manner that describes the claimed inventions.

Finally, in the absence of any architecture or hardware reference, the specification provides numerous brief descriptions of image processing operations. On example of an image processing operation appears at specification page 388, which states (in part):

> "Therefore, a tree image can be oriented, positioned, scaled, warped and overlayed on a background image; occulting the background image, occulting portions of more remote objects, and being occulted by portions of nearer objects. Moving occulted features can be seen between the cropped portions of occulting overlays; i.e., a partially occulted tank image can be seen between the leaves of an occulting tree image as it moves behind the tree image and can be seen as it moves past the external outline of the tree image. Occulting can be performed ..."

For another example, specification page 409 states (in part):

> "Images can be stored in the database in compressed or in non-compressed form. Storage in compressed form reduces the memory requirements and involves de-compression to restore the image. Storage in non-compressed form requires greater storage capacity, but does not need de-compression."

These and the many other miscellaneous image processing operations are described throughout the specification as possibilities, or capabilities of the overall system rather than as coherent embodiments and cohesive descriptions that tie them together; especially in a manner that describes the claimed inventions. For example, overlaying is described as something that "can be" done, and compressed and non-compressed image are described as ways that images "can be" stored. The overlaying and compressed/de-compressed descriptions above are not described in connection with one another. However, the claims tie such disparately disclosed image processing operations together (an example is provided below). For example, there is no description storing a compressed image, decompressing the image, and then overlaying the decompressed image. The reason this example is used here will become evident later. However, the point of this example is that linking disparate, suggested capabilities of the specification (such as the overlaying and compression/de-compression suggestions cited from the specification above) in the absence of any suggestions, or guides for doing so does not bespeak of possession. Furthermore, few if any of the miscellaneous image processing operations or capabilities described in the specification are linked to any of the specific architectures, or any particular set of hardware/processing options within the architectures.

Again, the specification is a mixing bowl of architectures, options, and miscellaneous image processing functions that lacks coherent embodiments and cohesive descriptions that tie

them together; especially in a manner that describes the claimed inventions. It is the examiner's contention that such a collection of possibilities and capabilities does not necessarily put the applicant in possession of a very specific claim that tie these "capabilities" together as a complete system.

The Claimed Inventions

The claims recite combinations of structural elements and functions, whereby the structural and functional elements are interrelated (i.e., using "in response to" language" and/or interconnected (i.e., using "coupled to" language) to form very specific systems. However, upon a thorough reading of the specification, it appears that claim combinations are not supported either by a coherent hardware embodiment or cohesive suggestions for linking multiple embodiments or miscellaneous capabilities, or by a single description of a particular image processing operation (such as the "overlaying" and "compression/de-compression" citations above). The claims appear to be combinations of the disclosed architectures, optional hardware structure and miscellaneous image processing operations that are individually described throughout the disclosure, but never described in conjunction with one another in a cohesive manner, or as part of a coherent embodiment. Thus, the question facing the examiner is whether the clamed combinations are supported by:

- a selected one of the applicant's disclosed architectures; and/or
- a coherent embodiment or a cohesive set of the applicant's disclosed input, supervisor, geometric, spatial, output, etc. options; and/or

- a cohesive combination of individually disclosed image processing operations.

The question is also whether the very selection of a specific architecture, a set of "capabilities" within the architecture, and a set of image processing operations is suggested, or guided by the disclosure without guidance from the claim itself. Stated another way, the question is whether there are suggestions, or a guide OTHER THAN THE CLAIM ITSELF that would lead to the above combination of disclosure options.

Again, the disclosed image processing system appears to be a collection of almost every type of input, processing, and output capability known to man at the time of filing. However, it's one thing to describe a collection of architectures having optional capabilities, but it's an all-together different thing to describe a specific system of interconnected and interrelated structural and functional elements.

<u>*In re Ruschig*, 154 USPQ 118 (CCPA 1967).</u>

The Ruschig court dealt with the issue of written description pertaining to a specific claimed invention, filed after the original filing date, given a generalized specification citing numerous examples and possibilities. The examiner is not attempting to equate the applicant's invention with the invention facing the Ruschig court. However, there are similarities with respect to the myriad of options and configurations posed by the applicant's disclosure, none of which were disclosed as being specifically configured to achieve the later claimed invention. The examiner cites the Ruschig decision because of the analysis and logical deduction laid out in the decision; the same logic relied upon by the examiner herein.

In the instant application, the applicant discloses a generalized and seemingly all encompassing set of image processing configurations and options, and now claims very specific configurations that were never set in stone in the original filing.

In Ruschig, and regarding the appellant's pointing to numerous disclosed options as supporting the specific claim, the court metaphorically stated:

> "It is an old custom in the woods to mark trails by making blaze marks on the trees. It is no help in finding a trail or in finding one's way through the woods where the trails have disappeared or have not yet been made, which is more like the case here to be confronted simply by a large number of unmarked trees. Appellants are pointing to trees. We are looking for blaze marks which single out particular trees. We see none."

Regarding the specific claim, the Ruschig court stated:

> "The trouble is that there is no such disclosure, easy though it is to imaging it. It is equally easy to imagine that the compound of claim 13 might have been named in the specification. Working backward from a knowledge [of the specific claim], that is by hindsight, it is all very clear what route one would travel through the forest to arrive at it. But looking at the problem, as we must, from the standpoint of one with no foreknowledge of the specific compound, it is our considered opinion that the board was correct in saying:
>
> Not having been specifically named or mentioned in any manner, one is left to selection from the myriads of possibilities encompassed by the broad disclosure, with no guide indicating or directing that this particular selection should be made rather than any of the many others which could also be made."

Again, the examiner is not equating the applicant's invention with that facing the Ruschig court. However, the problem faced by the examiner and the logic of the court are similar.

Regarding the instant application, and given many (but not all) of the applicant's claims, working backward it is "all very clear what route one would travel" through the specification to arrive at it. But looking at the problem from the "standpoint of one with no foreknowledge", it is

the examiner's contention that given the specification and drawings, one is left to "select from the myriads of possibilities encompassed by the broad disclosure, with no guide indicating or directing that this particular selection should be made rather than any of the many others which could also be made." In an effort to exemplify this, an example claim will be discussed below. In order to determine whether the claims have adequate support, the examiner has read the originally filed disclosure looking for coherent embodiments, or any type of guidance or cohesion that (while not exactly) at least reasonably convey to one skilled in the art that the applicant had possession of the now claimed inventions.

The Applicant's Claimed Inventions Lack Written Description Support

Each pending claim recites a combination of individual claimed elements, where the elements are modified by their interrelations (e.g., the "in response to" language). That is, each pending claim as a whole (i.e., the claimed combination) defines a system whereby the claimed elements interact very specifically with one another according to the claimed interrelations. **The claimed elements are inextricably linked to each other by the claimed interrelations, thereby defining a symbiotic system of elements.**

Upon a thorough analysis of each claim based upon the criteria set forth above, the examiner has concluded that the applicant's original disclosure fails to provide written description support for the pending claims; all of which were added well after the original filing date. In order to explain the examiner's analysis, and in view of the extreme number of claims currently pending, the example claim will be followed by an explanation of the original

disclosure inasmuch as it supports that claim. In addition, a brief explanation of the applicant's "product" claims will be provided.

Example Claim

Claim 554 will again be used to exemplify how the claimed combination of elements, along with the claimed interrelations between the elements is not supported (i.e., written description support) by the original disclosure.

554. (Currently amended) A process comprising the acts of:

storing computer instructions;

generating GPS navigation information in response to the computer instructions;

generating radar information;

generating data compressed image information in response to the computer instructions and in response to the radar information; and

loading database information into a database memory in response to the computer instructions and in response to the radar information.

While one claim is exemplified here, ALL of the pending claims have been examined using the same analysis, and NONE have been found to possess adequate written description support for the reasons described herein.

Criteria

In order to determine whether, and where written description support for the example claim exists, the examiner is reading the original disclosure for:

- A coherent embodiment that descries the entire combination of claimed elements, along with the interconnections and interrelations between them; or
- A partially disclosed embodiment, with cohesive suggestions or guides for modifying that embodiment to achieve the claimed invention; or
- Given the numerous disclosed architectures, input, processing and output options of each architecture, and the miscellaneous disclosed image processing operations, the examiner is looking for guides in the specification that tie together a disclosed architectures and/or a selected set of the disclosed options and/or a selected one or more of the disclosed image processing operations;

any of which provides a description that would "clearly allow persons of ordinary skill in the art to recognize that [he or she] invented what is claimed.'" *Id.*, 19 USPQ2d at 1116 (quoting *Gosteli*, 872 F.2d 1008, 1012, 10 USPQ2d 1614, 1618 (Fed. Cir. 1989)). Again, as in the Ruschig decision, the examiner is reading the specification from the "standpoint of one with no foreknowledge" of the now claimed invention. Further, an "anticipation" standard, not an "obviousness" standard is relied upon. However, the examiner cannot find his way through the forest; at least without the claim as a guide and a lot of "obviousness".

Example Claim Analysis

The originally filed claims do not describe the currently claimed subject matter, and thus cannot be relied upon as a written description thereof per se.

The drawings do not depict the claimed system per se. However, this is not uncommon because drawings are often vague and generalized, and the specification is the vehicle that provides the details.

The specification was read for any coherent or even partial embodiment (with suggestions, or guides) that describes the structure and functional interconnections and interrelations of the example claim. The examiner could not find a coherent description of the complete set of operations required by the claim. Likewise, the examiner could not find a partial embodiment with cohesive suggestions, or guides to other embodiments that would, together, describe the claimed invention. What was found will be discussed below.

Finally, with the above search for coherent or partial embodiments exhausted, the specification was read for the individual image processing operations pertaining to the individual claim elements. Many of the individual operations can be found in disparate sections of the specification, but having no apparent relationship with one another; at least without the claim as a guide. For example, the example claim requires a relationship between generating GPS navigation information, radar information, data compressed image information and loading a database memory.

GPS navigation information is described in one paragraph of the specification at page 387, as follows:

"In a military application; overlays can be related to fire control, bombing, sensors, and navigation. Navigation information can include GPS, inertial, celestial, radar, Tercom, dead-reckoning, and other navigation information. Sensor information can include radar, infra-red, video, sonar, and other sensor information."

Here, the specification describes possible "military applications" without actually describing what the applications are. GPS navigation is described as being one type of "navigation information" used in a military application. In addition, "sensor information" includes "radar". However, there is no link between the two here. That is, there is no description of both GPS and radar information being generated together, as part of the same method. There is nothing in this passage that would guide one to first generate GPS navigation information, and then to generate radar information.

"Radar" is discussed in several places in the specification, as follows:

Page	**Text**
25	1) Video sensor a) Vidicon b) Orthocon c) Infrared d) Radar e) Sonar
49	"Input device 132A may be a data acquisition system such as a radar, sonar, video, or other system for acquiring an image; a database memory; or other input device."

50	"Input signals 132M may be scan-related signals; such as raster scan signals for a video input, PPI or polar coordinate scan signals for sonar and radar systems, or other scan-related signals."
57	"For example, input memory 132B may store a large map of an environment (either sonar, radar, video, or otherwise) and output memory 132D may store a portion of the environment pertinent to the operation in progress, such as the portion of the environment around a vehicle being navigated."
64	"The filtering teachings herein are generally applicable, such as for spatial and temporal filtering of radar, seismic, and sonar systems ..."
70	"For example, an input data stream can be generated from a digitized input; such as from a camera, sonar receiver, or radar receiver; and can be scanned into image memory with geometric preprocessing."
387	"Navigation information can include GPS, inertial, celestial, radar, Tercom, dead-reckoning, and other navigation information. Sensor information can include radar, infra-red, video, sonar, and other sensor information."

441	"Such a map display can have superimposed overlays, such as topographical overlays for terrain and radar overlays for registering of radar images with terrain map images."
455	"For example, a video camera in the RPV can provide video images, a radar system in the RPV can provide radar images, a side-looking radar (SLR) in the RPV can provide SLR images, a forward-looking infrared (FLIR) system in the RPV can provide FLIR images, and other sensors in the RPV can provide other images."

However, other than at page 387 as discussed above, there are no links between GPS and radar information. In addition, either alone or in combination, there is no description or any links to a description of generating data compressed image information and loading database information in response to the "radar" information as claimed. In the absence of the claim itself, there are no guides that would lead one to generate data compressed image information and load database information in response to radar information; without the claim itself. There are no links, cohesive suggestions or guides that would lead to a such a disclosure.

It is true that the terms are described, individually, as "capabilities", or "options". However, there is no description of them being performed together in the manner claimed, and there is no description of which hardware configuration and selected options therein performs the acts. Again, the examiner has read the originally filed disclosure looking for coherent

embodiments, or any type of guidance or cohesion that (while not exactly) at least reasonably convey to one skilled in the art that the application had possession of the now claimed inventions. In this case, the examiner cannot find any cohesive link between the claimed elements.

One might speculate as to whether the generalized hardware configurations are the guides that lead a path (i.e., provide the link) between the disparately disclosed image processing operations. After all, several generalized hardware configurations along with numerous options pertaining to many of the claim elements are disclosed. However, there is nothing in the description of the image processing operations (e.g., see the specification citations above) that point to any of the disclosed architectures or hardware options therein. Further, there are no references in the architecture or hardware configuration descriptions that point to any of the miscellaneous disclosed image processing operations (e.g., the specification citations above). There are no links between the two. Again, the specification discloses various architectures, various input, processing and output options, and numerous miscellaneous image processing operations scattered throughout. There are no cohesive suggestions or guides that link them in a manner that leads one to the claimed invention. The hardware configurations are not the glue that binds the miscellaneous image processing operations together to form embodiments commensurate with the claims. In order to do this, the claim would be needed as THE guide. However, without foreknowledge of the claim, the examiner does not believe anything in the specification would guide one to the claimed invention. Given the original disclosure, the examiner cannot find evidence (via. guides) of possession of the now claimed invention.

Neither the sections of the specification cited above, nor any other section of the specification points to any one of the aforementioned hardware configurations, let alone any particular set of the selected and intermixed options within the selected hardware configuration that would lead to the example claim. Again, it is agreed that numerous hardware configurations and countless options therein are disclosed. ***However, a disclosure of numerous configurations and options from which to select does not constitute a disclosure of a particular selection. The selection was made in effect when the claim was drafted.*** As stated above, it is "not a question of whether one skilled in the art might be able to construct the patentee's device from the teachings of the disclosure .... Rather, it is a question whether the application necessarily discloses that particular device." (*Jepson v. Coleman*, 314 F. 2d 533, 536, 136 USPQ 647, 649-50 (CCPA 1963)).

Furthermore, looking at the problem from the "standpoint of one with no foreknowledge" of the now claimed invention, it is the examiner's contention that given the specification and drawings, one is left to "select from the myriads of possibilities encompassed by the broad disclosure, with no guide indicating or directing" that this particular selection (i.e., pertaining to the claimed combination of elements) should be made "rather than any of the many others which could also be made." (see the In re Ruschig section above). For example, there is nothing in the specification pages cited above that guides one to generate GPS navigation information, and then to generate data compressed image information and to load database information in response to radar information. Yes, the terms are mentioned in disparate sections of the specification as a capability. However, where is the guide that links them? There is no path between them. Reading the specification in the absence of the claim, and from the standpoint anticipation and

not obviousness (i.e., attempting to understand what the applicant actually invented), it the examiner's contention that the specification would not lead one to the claimed invention. To draw this conclusion, the claim would be needed as a guide, and obviousness would necessarily be relied upon. However, this is NOT the proper criteria for the fulfillment of written description.

Likewise, the remainder of the pending claims lack written description; many of which have the same, similar and even far more interconnected and interrelated limitations than that of the example claim. The example claim, together with a full accounting of the legal criteria and the manner in which the law has been applied has been provided. All of the pending claims have been examined using these criteria; and none of the above-identified claims have been found to possess written description support. Other examples of claim limitations that appear in various combinations (i.e., in a mix-and-match fashion) are provided immediately below. These limitations, most of which are described as examples or possibilities in disparate sections the specification, likewise do not possess guides that link them in the manner claimed:

8 X 8 blocks of image information; 64-pixel blocks of image information; Altitude/Altitude information; Analog-to-digital converter/conversion; Anti-Ailiased (or Anti-Aliasing); Architecture/Architectural; Artificial Intelligence; Aspect Ratio; Associative Database; Azimuth; Background information/images; Boundary processing; Color; Composite; Communications link; Comparison information; Compression; Spatial Compression; Data Compression; Computer aided design or manufacturing; Computer program/instruction; Convolution; Crop/Cropped; Irregular cropping; Data link; Database; Searching a database; Saving to a database; Delta; Delta Vector; Demultiplexing; Detail reduction/reduced detail; Disk drive; Optical disk; DVD; Digital disk; Distance information; Driving Function; Elevation information; Error Bounding; Expansion; Extrapolate/Extrapolation; Feature Scale Information; Filtering; Low pass filtering; Smoothing; Kernel filtering; Foreground; Frequency reduction; Fourier; Transform; Frequency domain information; Graphical Altitude Information; Graphical/Graphics information; Inertial Navigation; Infrared; Interlaced; Interpolation; Temporal interpolation; Spatial interpolation; Iterative (e.g., iterative compression, iterative

processing, etc.); Kernel; Kernel weights/weighting; Look up table (LUT); Mapping – Mapping Through A Transform; Mask; Memory Map/Mapped; Multiplex/Demultiplex; Mosaic; Motion/Moving images; Navigational information; Null, or Nulled (e.g., generating nulled information); Occlude/Occluding; Occult/Occulting; Outer Loop Correction; Oversampling; Overlay/Overlaying; Pattern Recognition; Perspective or 3D perspective; Pitch (e.g., generating "pitch" information); Product (e.g., making a "product"); Progressive (e.g., progressive compression, progressive processing, etc); Polygon; Radial; Radar; Range information; Range Variable; Reduced detail image information/Detail reduction; Relational Database; Robot; Roll (e.g., generating "roll" information); Rotate/Rotation; Scale/Scaling;Shaded Weights; Shadow Processing/Shadow Image; Shear; Signal; Signature (e.g., Signature Modulation/Demodulation); Spatial Interpolation; Sub-pixel; Three Dimensional Perspective (3D perspective); Tomographic; Topographical altitude information; Translate/Translation; Terrain altitude information; Texture; Ultra-Sound; Undersampling; Variable Range Compression; Vector; Warp; Weighting; Weighting and Scaling; Window/windowing; Wrapped Around; Yaw (e.g., generating "yaw" information); Zoom/Zooming.

Given the extreme number of pending claims, this table is not exhaustive. However, the applicant has been put on notice as to how the law has been applied, and the nature of the limitations that in combination are not supported by the original disclosure.

In summary, upon a thorough reading the applicant's specification from the standpoint of one with no foreknowledge of the now claimed invention, the examiner did not find:

- A coherent embodiment that descries the entire combination of claimed elements, along with the interconnections and interrelations between them; or
- A partially disclosed embodiment, with cohesive suggestions or guides for modifying that embodiment to achieve the claimed invention; or
- Guides in the specification that lead to a selected one of the disclosed architectures, with a selected set of the disclosed options, and/or coupled with a selected one or ones of the disclosed image processing operations;

any of which provides a description that would clearly allow persons of ordinary skill in the art to recognize that he invented what is now claimed. There are no embodiments or cohesive descriptions in the applicant's specification that anticipate the claimed inventions.

It is the examiner's opinion that in order to find a written description of the claimed inventions, the claims would be needed as a guide, and obviousness would necessarily be relied upon; neither of which is appropriate. That is, given the claim itself as a guide, it may have been obvious to interconnect the disparately disclosed elements to achieve the claimed results. However, this is not the criteria upon which the written description requirement is based, as explained above. ***The question is whether or not the applicant invented the claimed subject, or whether the original disclosure anticipated the claimed subject matter, BEFORE the claim was drafted.*** In this case, it is the examiner's contention that the answer is no.

PRODUCT CLAIMS

Many of the currently pending dependent claims recite limitations for making "products". These "product claims" as they will be referred to are of two types: Product claims directed to generalized, unspecified products and product claims directed to specific products. Both will be addressed below.

Generalized Product Claims

Many claims recite limitations for making a generalized "product". Examples of generalized product claim language includes making a product (alone), a first product, a second product, a third product, a display product, a design product, a graphic product, designed

product, data decompressed product, a processed product, a manufactured product, a communication product, a communicated product, an information product, etc. These are all example of a generalized, unspecified products.

A review of the specification reveals that, with one exception, variations of the term product is used in the specification only in a mathematical sense (such as for multiplication or a sum-of-products). For example, page 64 of the specification states (emphasis added):

> "The filtering teachings herein are generally applicable, such as for spatial and temporal filtering of radar, seismic, and sonar systems; kernel processing of information; multiplier and sum of the **products** architectures for computations; table processing as with the weight table architecture; and latching of multiple parameters in multi-parameter registers for parallel processing."

However, as stated above, the claimed "product" is a manufacture. The only other reference to a product is on page 454 which recites (emphasis added):

> "[A]lthough the final **product** of a graphic art system may be static photographs, real time operation permits an operator to efficiently and rapidly configure images."

While this one sentence appears to be discussing a photograph as being a product of a graphic arts system, this is nothing more than an axiomatic statement. It does not appear to be linked to any specific embodiment of the specification.

However, the generalized product claims recite the act of making a product "in response to" another claim. Given that the claims from which the generalized product claims depend lack written description, the generalized product claims lack written description as well. That is, in

order to provide written description for any of the generalized product claims, including the example claim above, the above quote from specification page 454 would have to link to the written description of the claimed method or system from which it depends. However, the applicant's specification does not do this.

In summary, the specification fails to provide written description support for the generalized "product" claim exemplified above, or for any of the other generalized product claims.

Specific Product Claims

Many claims recite limitations for making more specific "products" that do not read on the aforementioned "static photograph" described at specification page 454. For example, many claims are directed to a "DVD" product, and "agricultural" product, an "oil" product", an "architectural" product, a "machined" product, etc.

First, the term "product" has been claimed throughout the prosecution history as a "manufacture" (i.e., a manufactured physical product, or a tangible product). Thus, the examiner will construe the term "product" in this sense.

Second, because the independent claims from which the specific product claims depend lack written description, the specific product claims lack written description as well (i.e., for the same reasons described in the "generalized product" claim rejection above). However, it will be pointed out that the specific product claims alone (even without considering the independent claim) lack written support.

There is no written description support in the original disclosure of making the above specific products, or any of the other claimed specific products, either alone or in response to anything. For example, there is not even a mention of an "architectural product", an "oil product", etc. There is simply no description in the specification, original claims or in any depiction in the drawings of the specific "products" per se (i.e., the products that do not read on the "static photograph), let alone the act of making these claimed products, and let alone making the products "in response to" the limitations of another claims.

As described above, a review of the specification reveals that, with one exception, variations of the term product is used in the specification only in a mathematical sense (such as for multiplication or a sum-of-products). Further as described above, the only other reference to a product is on page 454 which recites (emphasis added):

> "[A]lthough the final **product** of a graphic art system may be static photographs, real time operation permits an operator to efficiently and rapidly configure images."

While this one sentence appears to be discussing a photograph as being a product of a graphic arts system, this statement does not provide written description support for the aforementioned specifically claimed product; let alone the act of making a product in response to the various steps or functionally claimed system elements of the claims.

In summary, the specification fails to provide written description support for the specific "product" exemplified above, or for any of the other specific products claimed.

Summary

In order to demonstrate a lack of written description, the examiner is faced with the task of proving a negative. That is, the examiner must show that the claimed subject matter is NOT present in the specification. In the case of the example claim above (and for every other claim), the elements recited therein along with their interrelations are not described by the original claims, they are not depicted in the originally filed drawings, and they are not described by the words of the specification. **Therefore, the examiner must conclude that, according to the relevant law (i.e., as described by the MPEP as well as the Guidelines), the applicant did not invent the subject matter that is now claimed, and one of ordinary skill could not reasonably conclude that he was in possession of the claimed invention(s) at the time the application was filed.** Furthermore, to date the applicant has made absolutely no attempt to show possession of the claimed invention; despite the filing of numerous lengthy responses that generally cite case law, and specifically allege that the examiner has not made a prima facie case.

The examiner suggests the following traversal of the written description rejection. **The applicant need only point to a coherent embodiment of the specification that discloses the entire claimed invention, including all of the elements and interrelations between the elements, using words, structures, figures, diagrams and formulas. In the absence of this, the applicant may point to the guides that would lead to a combination of a disclosed hardware configuration, with a particular set of disclosed input, processing and output options, that ties together the disparately disclosed image processing operations in the manner claimed; and without foreknowledge of the now claimed invention and without relying obviousness.** Thus far in the prosecution history, the applicant has made no attempt to do so.

The question is whether or not the applicant invented the claimed subject matter, or whether the original disclosure anticipated the claimed subject matter BEFORE the claim was drafted; NOT whether the applicant invented a system from which the now claimed invention would have been obvious in view of the claim itself.

Enablement

5. All pending claims continue to be rejected under 35 U.S.C. 112, first paragraph, as failing to comply with the enablement requirement. The claim(s) contains subject matter which was not described in the specification in such a way as to enable one skilled in the art to which it pertains, or with which it is most nearly connected, to make and/or use the invention. The previous enablement rejection is incorporated herein by reference.

Prior Art Rejections

6. The terms of the claims will be construed in accordance with their plain meaning and/or or in accordance with the specification in the following manner:

Anti-Ailiased (or Anti-Aliasing): Aliasing is usually manifested as a jaggedness effect usually found on edges within the image. An image that is anti-ailiased is processed in a manner that removes or reduces aliasing, or precludes aliasing from happening. One such processing is low pass filtering, or smoothing to eliminate high frequencies that cannot be properly sampled by the image resolution.

Artificial Intelligence: Not specifically defined by the specification. Construed broadly by the examiner as any intelligence decision (i.e., based on data) made by a machine. For example, the comparison of images to find differences, or an adjustment to images based on pixel information to improve quality, etc.

Aspect Ratio: Ratio of image width to height (i.e., NTSC television has a 4:3 aspect ration, or 1.33).

Associative Database: A database storing a set of "Items" and a set of "Links" that connect them together.

Compression:

Spatial Compression: Compressing or scaling an image to make it smaller (in size) in at least one dimension.

Data Compression: Compressing an image/data to reduce the data content; either lossy or lossless.

Convolution: Well known definition. Broadly, the convolution approach can process kernel weights, or intensities to provide new output intensities for a pixel.

Crop/Cropped: To cut, or trim. To remove from.

Database: Broadly – a memory.

Delta: Representing change.

Delta Vector: An array of numbers (i.e., a "vector") representing a change, such as but not limited to a slope (i.e., "delta" means change).

Demultiplexing: See Multiplexing/Demultiplexing below.

Driving Function: A function, equation, variable, condition, term, etc. that causes (i.e., drives) an image processing device or image processing operation. Operator inputs that cause an image to change (e.g., be rotated, translated, etc.) can be a driving function, an equation can drive an image transformation, etc.

DVD: Construed as a "digital video disk", because the well know "digital versatile disk" of today had not been invented yet.

Error Bounding:

1. Reducing or correcting built-up error, such as during a progressive image processing operation.

2. Controlling or confining error to boundaries; limiting error.

Expansion:

Spatial Expansion: Expanding or scaling an image to make it larger (in size) in at least one dimension.

Data Expansion: Opposite of compression; uncompressing a data compressed image.

Extrapolate/Extrapolation: Similar to interpolation. To extrapolate is to infer or estimate by extending or projecting known information. E.g., "the datas can be interpolated between points or extrapolated from points in a single dimension" at specification page 436. An "interpolation" is an extrapolation.

Feature Scale Information: Information having to do with the scale, or scale factor of an image or feature within an image. Broadly construed, feature scale information is information regarding the scale (i.e., size) of an image or feature within the image.

"Generating": Interpreted broadly as "inputting". Could also mean the act itself. For example, "generating compressed image information" could mean inputting the information, or it could mean actually compressing the image.

Graphical Altitude Information: Graphics, or images that have height, or altitude associated with them. For example, and image of a tree has altitude, in that the tree rises above the ground. A mountain has altitude, a plane has altitude information, etc.

Inertial Navigation: Navigation using non-satellite or radio means. For example, using a gyroscope or accelerometers (both of which rely upon inertia).

Iterative (e.g., iterative compression, iterative processing, etc.): Taking place in a series of iterations, or repeated steps; see "progressive" below.

Mapping – Mapping Through A Transform: Mapping implies transferring an input pixel (or other data) to an output destination. Specification page 50 states, "The line generators can be used to map pixels from an input memory map into an output memory map." Mapping through a transform implies transforming the pixels prior to storing them in the output destination.

Memory Map/Mapped: When a 2D image is stored in a memory, it is said to be memory mapped (i.e., each pixel of the image is mapped to a specific memory location). Broadly, an image that is stored an 2D image memory "is" memory mapped.

Multiplex/Demultiplex: To combine; e.g., combine a plurality of data or channels into one set of data or on one channel. Demultiplexing is the opposite.

Null, or Nulled (e.g., generating nulled information): To "null" is to make into "nothing". For example, during image registration, registration errors are nulled or made a low as possible.

Outer Loop Correction: During a progressive (see below) image processing operation, using the initial image to reduce/correct error built-up in the progressively processed image.

Oversampling: Adding new pixels to an image.

Pattern Recognition: Specification page 455 states, "pattern recognition to identify meaningful image features and to derive the characteristics and geographical location of the features of interest". Thus, interpreted broadly, "pattern recognition" is the act of identifying image features, or patterns within an image.

Perspective or 3D perspective: The quality of an image that appears to be transformed into a third dimension. For example, a 3D perspective is caused by rotation of an image about the X-axis to tilt the top of the window backward into the third dimension.

Pitch (e.g., generating "pitch" information): Pitch, such as the pitch, yaw and roll of a vehicle. Pitch refers to the alternate lift and descent of the nose and tail of an airplane or other vehicle. Refer to the following quote from the specification for context:

"Camera images can be simulated; dynamically driven as a function of vehicle roll, **pitch**, and yaw dynamics; vehicle altitude; and other parameters. A map display can be provided for displaying a terrain map, such as on a cockpit display for a pilot."

Product (e.g., making a "product"): Any product, including a signal, or an image, or a physical product. NOT a mathematical product (i.e., multiplication).

Progressive (e.g., progressive compression, progressive processing, etc.): Processing an image in iterations, or steps, were each step makes more and more progress. For example, an image can be progressively compressed, such as compressing the image by 90% for one iteration, then compressing the 90% compressed image by another 90% to 81% for a second iteration, and then compressing the 81% compressed image by another 90% to 72.9% for a third iteration; yielding three 90% compressions for a 72.9% compression. This progressive compression can be performed over many iterations.

Radial: Radiating from or converging to a common center.

Range Variable: According to the applicant's specification, "range variable" refers to processing different parts of an image differently. For example, a square/rectangular image can be spatially compressed increasingly along the Y axis, yielding a keystone effect.

Relational Database: A database accessed and organized according to the relationships between data items.

Remote: Not physically a part of; away from. For example, a monitor is remote from the computer (i.e., not built-in to the computer).

Robot: Any moving machine or vehicle that is controlled by another machine or man (an mechanical arm, a boat, an airplane, etc.)

Roll (e.g., generating "roll" information): Roll, such as the pitch, yaw and roll of a vehicle. Roll refers to rotation about the longitudinal axis of an airplane or vehicle. Refer to the following quote from the specification for context:

"Camera images can be simulated; dynamically driven as a function of vehicle **roll**, pitch, and yaw dynamics; vehicle altitude; and other parameters. A map display can be provided for displaying a terrain map, such as on a cockpit display for a pilot."

Shaded Weights: Defined according to the applicant's specification. Specification page 112 states,

"For example, anti-aliasing may be implemented with a 3-pixel-by-3-pixel kernel overlapping other kernels by 1-pixel on each side and shaded so that the pixels have lower weights as they get further from the center pixel."

The, the term will be construed as follows: Weights, for example, in a filter kernel, where the weights decrease away from the Kernel center (where the weights are decreasing from the kernel center towards the kernel periphery).

Shadow Processing/Shadow Image: Broadly, adding a shadow. For example, shadow processing can be performed by projecting a source of illumination onto topological altitude variations of an image and storing projected shadows.

Signal: Any waveform that carries information, including an image signal.

Signature (e.g., Signature Modulation/Demodulation): Unknown – not defined in the specification and not established in the art. "Signature" will be construed as a "signal" (e.g., signal modulation, signal demodulation, etc.).

Spatial Interpolation: Within an image (i.e., a 2D image), the addition of new pixels between existing pixels by interpolation.

Surveillance: The act of observing. An image that observes a scene is a surveillance image.

Three Dimensional Perspective (3D perspective): The quality of an image that appears to be transformed into a third dimension. For example, a 3D perspective is caused by rotation of an image about the X-axis to tilt the top of the window backward into the third dimension.

Tomographic:

Typically, a tomographic image is related to any of several techniques for making detailed x-rays of a predetermined plane section of a solid object while blurring out the images of other planes. However, the term is used in a broader manner in the specification and claims. For example, the only definition of "tomographic" in the specification appears at specification page 441, which states:

"In a medical application, the medical investigator can investigate tomographic, X-ray, and ultrasound images ... For example, a large highly detailed medical image, such as a tomographic image, can be stored as a group of mosaics in database memory."

Here, the specification appears to distinguish "tomographic" from an "x-ray", while defining it as a "group of mosaics" in a memory.

Thus, the term "tomographic image" will be interpreted broadly, both in accordance with the plain meaning and the specification, as follows:

A group of images representing an object in three-dimensions (i.e., a group of images that when taken together represent an object in all three dimensions).

Ultra-Sound: Acoustic energy greater than the upper threshold of hearing, which is typically considered 15KHz. The, frequencies of acoustic energy greater than 15KHz are considered ultra-sonic, and are there ultra-sound frequencies.

Undersampling: Removing pixels from an image.

Variable Range Compression: Spatially compressing different parts of an image differently. For example, a square/rectangular image can be spatially compressed increasingly along the Y axis, yielding a keystone effect.

Vector:

1. An array of numbers.

2. A number having magnitude and direction.

Warp: Both linear and non-linear warping of an image. Linear includes affine transformation (i.e., rotation, scale, translation) and non-linear warp includes perspective change, keystone, pincushion, etc.

Wrapped Around:

1. As in the lines of a raster image, where at the end of an image line, the data is wrapped around to the beginning of the next line.

2. A 2D image wrapped around a 3D surface.

3. In a memory, where an image is translated in one direction in the memory and the data are wrapped around to the other side of the memory so it is not lost.

Window: A square or rectangular image.

Yaw (e.g., generating "yaw" information): Yaw, such as the pitch, yaw and roll of a vehicle. Yaw refers to a turn about the vertical axis of an airplane or vehicle. Refer to the following quote from the specification for context:

"Camera images can be simulated; dynamically driven as a function of vehicle roll, pitch, and **yaw** dynamics; vehicle altitude; and other parameters. A map display can be provided for displaying a terrain map, such as on a cockpit display for a pilot."

Claim Rejections - 35 USC § 102

7. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless –
>
> (a) the invention was known or used by others in this country, or patented or described in a printed publication in this or a foreign country, before the invention thereof by the applicant for a patent.
>
> (b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.
>
> (e) the invention was described in (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effects for purposes of this subsection of an application filed in the United States only if the international application designated the United States and was published under Article 21(2) of such treaty in the English language.

8. Claims 187, 209, 235 and 279 are rejected under 35 U.S.C. 102(b) as being anticipated by Netravali et al (U.S. 4,245,248 A).

Netravali discloses generating multiplexed image information (input data from channel 60 is multiplexed image information, see figure 5); generating demultiplexed first channel image information by demultiplexing in response to the multiplexed image information (see figure 6, output 603 from demultiplexor 602 is the claimed "demultiplexed first channel image information"); and generating demultiplexed second channel image information by demultiplexing in response to the multiplexed image information (output 604 is the claimed "second channel image information").

Netravali discloses the act of making a position product (the position product in Netravali is image data).

Netravali discloses generating a frame of input image information (frame input, figure 2); generating a frame of data compressed image information in response to the frame of input image information (output of linear transform 101); generating a frame of data decompressed image information in response to the frame of data compressed image information (output of inverse transform 201); generating a frame of feedback image information in response to the frame of data decompressed image information (output of buffer 203); and generating the frame of data compressed image information in response to the frame of feedback image information (output of linear transform 204).

Netravali discloses the act of making a product (a product in Netravali is image data).

Netravali et al. disclose a process comprising the acts of: storing database memory management information (see column 6, lines 11-15: The reference describes that each of the memories 301 and 302 include address inputs for receiving address information (i.e. database memory management information).); storing frames of image information in a database memory

(see column 6, lines 5-11: The reference describes that intensity information representing the versions of the picture which precede and follow the picture being estimated (i.e. frames of image information) are stored in random access memory (i.e. database memory).); and generating output frames of image information by accessing in response to the frames of image information stored in the database memory in response to the associative database memory management information (see column 6, lines 22-26: The reference describes that several picture elements are output from the memories 301 and 302 based on the intensity information representing the versions of the picture which precede and follow the picture being estimated (i.e. frames of image information) and the address information (i.e. associative database memory management information).).

9. Claim 472 is rejected under 35 U.S.C. 102(e) as being anticipated by Grumet (US 4, 601, 053 A).

Grumet discloses:

generating a first channel of output image information representing a first perspective of an image (figures 1a and 1b, left camera view; figure 4, numeral 108);

generating a second channel of output image information representing a second perspective of the image, wherein the second perspective of the image is from a different x-axis position of the first perspective of the image (figures 1a and 1b, right camera view; figure 4, numeral 110); and

generating multiplexed image information in response to the first channel of output image information and in response to the second channel of output image information (figure 4, numerals 112 and 114; or 128-134, or figure 5a, numeral 165).

10. Claims 117, 148, 151, 173, 217, 229 and 385 are rejected under 35 U.S.C. 102(e) as being anticipated by Meagher (US 4,694,404 A).

Meagher discloses a system (figure 15) for acquiring x-ray images and generating a tomographic reconstruction (figure 15, numeral 129), whereby the user can rotate, translate and zoom/scale the images for display and thus simulate moving through a 3D environment within the scanned object (figure 15, numeral 150).

Meagher also discloses the following claimed features:

Interpolation:

"In some cases, additional slices are generated between original slices by interpolation in order to improve image quality." At column 35, line 30.

Medical Images:

"For example, medical image generation, the DATA ACQUISITION block 129 may comprise scanning the object with a CT (Computed Tomography) scanner and generating a plurality of data slices, each slice comprising a plurality of cells having attached to them location and density information." at column 32, line 68.

Rotation of an Image:

See Warping.

Scaling/Zooming of Images:

See Warping.

Tomographic/Tomography:

"For example, medical image generation, the DATA ACQUISITION block 129 may comprise scanning the object with a CT (Computed Tomography) scanner and generating a plurality of data slices, each slice comprising a plurality of cells having attached to them location and density information." at column 32, line 68.

Translation of Images:

See Warping.

Three Dimensional Images/Perspective Images/Roam through 3D environment:

"The INTERACTION WITH USER block 150 allows a user to interact with the IMAGE DISPLAY PROCESSOR block 152 through the INITIALIZING CONTROLLER block 160 to select a viewing angle (i.e. to rotate and translate the three-dimensional object with respect to the view plane), to select the scale of the image to be displayed, to select the coloration and shading

of the displayed image, to define cut planes for the generation of sectional views, to select when an image is to be displayed, etc." at column 33, line 63.

"For instance, a user may translate the origin 210 of the projection 211 to any point on the view plane 66. The Interaction With User block 150 further permits the user to rotate the three-dimensional coordinate system (x, y, z) about a user-defined point in the three-dimensional universe with respect to view plane 66 to any given rotational orientation. Finally, a user may scale the dimensions of the three-dimensional universe (the Interaction with User block 150 suitably permits independent scaling for each of the x, y, z dimensions). Another possible linear transformation that could be performed by the Initializing Controller block is skewing of the three-dimensional universe in each of the x, y and z dimensions. Shown in FIG. 20(A) is a three-dimensional coordinate system for a given translational and rotational orientation and having a given set of scaling factors with respect to the two-dimensional view plane 66." At column 52, line 8.

Ultrasound Images:

"Ultrasound Scanner" at column 1, line 36.

X-ray source and camera/detector:

"For example, medical image generation, the DATA ACQUISITION block 129 may comprise scanning the object with a CT (Computed Tomography) scanner and generating a plurality of data slices, each slice comprising a plurality of cells having attached to them location

and density information." at column 32, line 68. An x-ray source and detector are inherent to CT scanners.

Warping:

Rotation, translation and scaling are all warping operations. Also see:

"For instance, a user may translate the origin 210 of the projection 211 to any point on the view plane 66. The Interaction With User block 150 further permits the user to rotate the three-dimensional coordinate system (x, y, z) about a user-defined point in the three-dimensional universe with respect to view plane 66 to any given rotational orientation. Finally, a user may scale the dimensions of the three-dimensional universe (the Interaction with User block 150 suitably permits independent scaling for each of the x, y, z dimensions). Another possible linear transformation that could be performed by the Initializing Controller block is skewing of the three-dimensional universe in each of the x, y and z dimensions. Shown in FIG. 20(A) is a three-dimensional coordinate system for a given translational and rotational orientation and having a given set of scaling factors with respect to the two-dimensional view plane 66." At column 52, line 8.

11. Claims 231, 388 and 527 are rejected under 35 U.S.C. 102(e) as being anticipated by Rogoff et al. (US 4,590,569 A).

Rogoff discloses:

An "on-board navigational system ... which continuously display in a plan view the present position of a navigating vehicle in relation to its surrounding environment, such as a ship making a passage within a channel or harbor or the like" at column 1, line 10.

In summary, as depicted in figure 4, Rogoff displays a color, composite depiction of a navigational chart superimposed with a radar image, and with moving graphic of the vessel itself, as well as moving graphics of other vessels and stationary objects detected using radar and depicting their current positions and headings. The charts are read out of chart files and pieced together to display the area of interest to the user. The vessel graphics leave a trail based on the vessel's heading and speed, where the vessel rotates or translates with changes in its position. Also displayed to the user are position and steering information.

The Rogoff system:

- Employs "both a highly accurate means for fixing positions of an object detection system along with an integrated electronic display" at column 2, line 8.
- Comprises "a navigational chart generated from a plurality of electronic charts stored as files in a char memory and generated in accordance with present computed position of the vehicle" at column 2, line 10.
- Is "particularly adapted for combining Loran with radar" at column 2, line 16.
- Where "an appropriate navigational chart is retrieved from the chart memory and generated as a color CRT display together with a graphic of the present vessel position and selected alpha-numeric steering and positioning information" at column 2, line 38.

- And where "the shore line and adjoining land mass [radar] echoes" are suppressed "in favor of that provided by the electronic chart" at column 2, line 45.

System Overview

A brief overview of the Rogoff system as read by the examiner will be provided in relation to figure 3, which describes the overall system.

Loran System: Loran receivers 22 and 24 serve to receive "radio pulses ... from three stations" (column 3, line 18) relating to longitude and latitude of the vehicle.

Radar: Radar system 26 transmits and receives a radar signal receiving a radar image of objects surrounding the vehicle.

Compass: A "gyro or magnetic compass" (column 8, line 64).

Memory: Stores Loran calibration data 32, way-point and object files 34, as well as electronic charts 36.

Way point and object file 34: Comprises "preconstructed data files containing information relative to certain way points and objects used in navigating the area of concern" (column 9, line 5).

Electronic chart files 36: Comprises "a plurality of electronic charts constructed from actual navigational charts containing longitude and latitude information as to shore

contours, channel boundaries, buoys, lighthouses, fixed structures, etc." (column 9, line 9). The charts are "broken into convenient chart segments ... and combined to meet the requirements of any scale chosen by the user" (column 9, line 18).

Computer: Performs all the necessary computations to control the display seen in figure 4.

Display: A color CRT for displaying the information seen in figure 4. It "comprises an electronic chart displayed as a television picture which is presented to the user via a color cathode ray tube ... together with a graphic of the vessel's present position on the chart as well as radar targets sensed ..." at column 9, line 25. Additionally, "alpha-numeric steering and positioning information is displayed" at column 9, line 28. Refer to figure 4.

The Hardware Processing Elements

The following bolded headings provide a more detailed description of each of the hardware processing elements of figure 3, as depicted in detail in figure 6:

Radar 26:

Vessel Position Computer 80:

This computer receives radio signals from receivers 78 and 24, and converts "Loran time differences to a geographic positions of longitude L and latitude λ" at column 11, line 21. "The

computed vessel position in longitude L and latitude λ appears as digital signals or output bus 82" at column 11, line 65.

Scan Table 84:

Selects " the appropriate electronic navigational chart for display from the chart files 36" at column 11, line 67.

"This is a continuing process and selection is based upon whether or not the latitude and longitude of the present vessel position is such to be contained within the outlines of a chart which may already be displayed. In the first instance, however, chart selection is made based upon the vessel's first calculated position" at column 12, line 3.

"Upon crossing this boundary, the selection process is resumed to deliver the next chart to the display, and the process continues as the vessel moves throughout the area of travel" at column 12, line 14.

Temporary Electronic Chart Memory 86:

"temporary electronic chart memory 86 which comprises three digital memory matrixes 88, 90 and 92 for the colors red, blue and green, respectively" at column 12, line 19.

Operates "to provide TV raster outputs to a cathode ray tube (CRT) 94 via a color table 96 which performs the function of controlling the combination of red, blue and green excitation of the CRT 94 in accordance with the rules laid down for the table" at column 12, line 25.

Hull Graphic Generator 100:

Operable "to generate the picture of the vessel as shown in FIG. 4 at the latitude and longitude coordinates of the vessel's computed position" at column 12, line 46.

Alpha-Numeric Data Computer 102:

Contains "data as to the location of predetermined way points and other objects needed for making a safe passage through the area of use. The computer 102, for example, is operable in accordance with stored programs included in the reference listing to compute bearing and distance to any way point as well as bearing and distance to any other place or object that is determined by the position of a cursor generated by means 104 which can be controlled by the operator" at column 12, line 58.

Radar 26:

"Three analog outputs are obtained from the radar 26 and are shown in FIG. 6 comprising signals of: (a) the scanned antenna azimuth angle relative to the fore and aft of the vessel; (b) the radar's receiver video signals which include target signals; and (c) the radar's synchronizer pulse" at column 13, line 40.

Polar/Rectangular Coordinate Converter 122:

"converted from polar coordinates into coordinates of longitude and latitude" at column 13, line 48.

"comprises a digital multiplier" at column 14, line 2.

"calculate X=R sin theta and Y=R cos theta which now comprise digital signals expressed in rectangular X and Y coordinates" at column 14, line 4.

Offset Adder 124:

"The adder 124 operates to add the offset of the vessel's current position in longitude L and latitude λ to the X and Y coordinate signals which operate to inherently and automatically match i.e. align the radar image with the displayed chart so that each target is correctly positioned to a relatively high degree of accuracy on the electronic chart displayed on the CRT 94. In other words, the radar image and the electronic chart will be merged into a composite display" at column 14, line 12.

Temporary Radar Display Memory 126:

"target signals are located in either of two matrix memories 128 and 130 calling for the color red or magenta depending upon the signal level of the video signal out of the radar 26 and which appears on signal line 132" at column 14, line 20.

"Shore contours and the adjacent land mass radar echoes comprise relatively strong target signals and are thus fed into and out of the red memory matrix 128 to the color table 96. Suppression of land echoes including shore contours in favor of that provided by the electronic chart displayed is achieved by means of the color table 96 which operates to inhibit any color signal except yellow from being coupled to the CRT 96 from the memories 86 and 126 if a yellow signal is being fed out of chart memory 86" at column 14, line 34.

Display CRT 94:

"simultaneous display of a map of radar targets detected by the radar 26 against the background of the electronic chart displayed on the CRT 94" at column 13, line 22.

"a combined display where the yellow shore line is portrayed in yellow and where the blue water is also capable of displaying red or magenta wherever there is an echo of a ship or other target. In this manner, a clarified display is provided in the sense that instead of seeing a normally relatively fuzzy, smeared and incomplete radar picture, there is presented a sharp yellow drawing of land, while there is provided a clear display of targets that are stationary or moving in the water. Additionally, since a moving target such as a ship is displaced each time a radar sweep occurs, the target will fall in a different place on the screen or the CRT 94 so that a red line is portrayed thereon which results from motion of the target such as another vessel under way. If it is a stationary target such as a lighthouse, the repetitive radar echoes will repetitively be displayed at a single spot. If a buoy, for example, has moved from its designated spot both its present location as provided by the radar and its proper location as provided by the electronic chart will both appear in the composite display" at column 14, line 60.

The Image Processing

The various types of data and images as well as the image processing operations disclosed by Rogoff are as follows:

Alignment:

See Registration/Alignment below.

Analog/Digital Converter:

Figure 6, numeral 120.

Associative Database:

Figure 3, numeral 30.

Architecture:

"A third file 36 comprises a plurality of electronic charts constructed from actual navigational charts containing longitude and latitude information as to shore contours, channel boundaries, buoys, lighthouses, fixed structures etc" at column 9, line 10.

Background Images:

"simultaneous display of a map of radar targets ... against the background of the electronic chart displayed" at column 13,line 23.

Boundary Processing/Smoothing:

"Shore contours and the adjacent land mass radar echoes comprise relatively strong target signals and are thus fed into and out of the red memory matrix 128 to the color table 96. Suppression of land echoes including shore contours in favor of that provided by the electronic chart displayed is achieved by means of the color table 96 which operates to inhibit any color

signal except yellow from being coupled to the CRT 96 from the memories 86 and 126 if a yellow signal is being fed out of chart memory 86" at column 14, line 34.

<u>Color Images</u>:

"comprises an electronic chart displayed as a television picture which is presented to the user via a color cathode ray tube ... together with a graphic of the vessel's present position on the chart as well as radar targets sensed ..." at column 9, line 25.

"The navigational display is in color" at column 9, line 40.

"red, blue and green" at column 12, line 21.

<u>Combine/Composite Images</u>:

The charts are "broken into convenient chart segments ... and combined to meet the requirements of any scale chosen by the user" (column 9, line 18).

"comprises an electronic chart displayed as a television picture which is presented to the user via a color cathode ray tube ... together with a graphic of the vessel's present position on the chart as well as radar targets sensed ..." at column 9, line 25.

"composite of a visual image and of an electronic navigational chart ... and a superimposed radar image whose scale and geographical coordinates match that of the chart generated" at column 9, line 38.

"simultaneous display of a map of radar targets ... against the background of the electronic chart displayed" at column 13,line 23.

Computer Program/Computer Instructions:

"software" at column 11, line 28.

"stored programs" at column 12, line 63.

Cropping/Cropped/Irregular Cropped:

"Shore contours and the adjacent land mass radar echoes comprise relatively strong target signals and are thus fed into and out of the red memory matrix 128 to the color table 96. Suppression of land echoes including shore contours in favor of that provided by the electronic chart displayed is achieved by means of the color table 96 which operates to inhibit any color signal except yellow from being coupled to the CRT 96 from the memories 86 and 126 if a yellow signal is being fed out of chart memory 86" at column 14, line 34.

Database/ Database Images/Searching Database Images:

"digital memory 30" at column 1, line 68.

Memory 36 stores "a plurality of electronic charts constructed from actual navigational charts containing longitude and latitude information as to shore contours, channel boundaries, buoys, lighthouses, fixed structures, etc." (column 9, line 9). The charts are "broken into convenient chart segments ... and combined to meet the requirements of any scale chosen by the user" (column 9, line 18).

"Hull graphic generator 100 which couples into the electronic chart memory 86 and is operable to generate the picture of the vessel as shown in FIG. 4" at column 12, line 45.

Expanded Image Information:

"nine of the prerequisite one mile square files will be combined to create a chart that portrays the required area" at column 9, line 20.

Graphics Information:

Hull Graphic Generator 110 is operable "to generate the picture of the vessel as shown in FIG. 4 at the latitude and longitude coordinates of the vessel's computed position" at column 12, line 46.

Inertial Navigation:

A "gyro or magnetic compass" at column 8, line 64. A gyroscope navigation system is an inertial system.

Iterative Processing:

"continuing process and selection is based upon ..." at column 12, line 1.

Map/Map Images/Map Display:

Rogoff stores and displays map images as depicted in figure 4 (i.e., "visual map navigation display" at column 9, line 14).

Memory Loading:

Scan table 84 selects " the appropriate electronic navigational chart for display from the chart files 36" at column 11, line 67.

"This is a continuing process and selection is based upon whether or not the latitude and longitude of the present vessel position is such to be contained within the outlines of a chart which may already be displayed. In the first instance, however, chart selection is made based upon the vessel's first calculated position" at column 12, line 3.

<u>Memory – RAM/Memory Processing</u>:

"digital memory 30" at column 11, line 68.

"temporary electronic chart memory 86 which comprises three digital memory matrixes 88, 90 and 92 for the colors red, blue and green, respectively" at column 12, line 19. Operates "to provide TV raster outputs to a cathode ray tube (CRT) 94 via a color table 96 which performs the function of controlling the combination of red, blue and green excitation of the CRT 94 in accordance with the rules laid down for the table" at column 12, line 25.

<u>Moving Images or Motion</u>:

"All moving targets ... are allowed to leave a trail of positions behind them which aids in establishing the direction of their true motion" at column 10, line 2. "length of the trail is the measure of the target's speed" at column 10, line 4.

"the chart may be made to move" at column 12, line 16.

<u>Multiplier:</u>

The polar convert 122 "comprises a digital multiplier" at column 14, line 2. "calculate X=R sin theta and Y=R cos theta which now comprise digital signals expressed in rectangular X and Y coordinates" at column 14, line 4.

Navigational Information:

Figure 3, the Loran, Radar and Gyro/Compass generated location information related to navigating the vehicle.

Figure 3, numeral 30 stores calibration, way point and charts related to navigation.

Overlaying:

"comprises an electronic chart displayed as a television picture which is presented to the user via a color cathode ray tube ... together with a graphic of the vessel's present position on the chart as well as radar targets sensed ..." at column 9, line 25.

"composite of a visual image and of an electronic navigational chart ... and a superimposed radar image whose scale and geographical coordinates match that of the chart generated" at column 9, line 38.

"simultaneous display of a map of radar targets ... against the background of the electronic chart displayed" at column 13,line 23.

Polar Coordinates/Polar Scan:

Figure 6, numeral 122.

"converted from polar coordinates into coordinates of longitude and latitude" at column 13, line 48.

"comprises a digital multiplier" at column 14, line 2.

"calculate X=R sin theta and Y=R cos theta which now comprise digital signals expressed in rectangular X and Y coordinates" at column 14, line 4.

Radar:

"comprises an electronic chart displayed as a television picture which is presented to the user via a color cathode ray tube ... together with a graphic of the vessel's present position on the chart as well as radar targets sensed ..." at column 9, line 25.

"Three analog outputs are obtained from the radar 26 and are shown in FIG. 6 comprising signals of: (a) the scanned antenna azimuth angle relative to the fore and aft of the vessel; (b) the radar's receiver video signals which include target signals; and (c) the radar's synchronizer pulse" at column 13, line 40.

Registration/Alignment:

"composite of a visual image and of an electronic navigational chart ... and a superimposed radar image whose scale and geographical coordinates match that of the chart generated" at column 9, line 38.

"The adder 124 operates to add the offset of the vessel's current position in longitude L and latitude λ to the X and Y coordinate signals which operate to inherently and automatically match i.e. align the radar image with the displayed chart so that each target is correctly

positioned to a relatively high degree of accuracy on the electronic chart displayed on the CRT 94. In other words, the radar image and the electronic chart will be merged into a composite display" at column 14, line 12.

Relational Database:

Figure 3, numeral 30.

Rotation and Translation of Image Information:

The "hull graphic", or "picture of the vessel" at column 12, line 45, rotates and translates in accordance with "the latitude and longitude coordinates of the vessel's computed position" (column 12, line 48). "The vessel moves throughout the area of travel" at column 12, line 15.

"since a moving target such as a ship is displaced each time a radar sweep occurs, the target will fall in a difference place on the screen" at column 14, line 63.

Scale/Scaling:

The charts are "broken into convenient chart segments ... and combined to meet the requirements of any scale chosen by the user" (column 9, line 18).

"nine of the prerequisite one mile square files will be combined to create a chart that portrays the required area" at column 9, line 20.

Sum/Summation:

"The adder 124 operates to add the offset of the vessel's current position in longitude L and latitude λ to the X and Y coordinate signals which operate to inherently and automatically match i.e. align the radar image with the displayed chart so that each target is correctly positioned to a relatively high degree of accuracy on the electronic chart displayed on the CRT 94. In other words, the radar image and the electronic chart will be merged into a composite display" at column 14, line 12.

Translation:

See Rotation and Translation above.

Warp/Warping:

See Scaling, Translation, Rotation and Expanding above. All are forms of image warping.

Wrap Around Image:

"automatic advance of the chart display to the next chart or chart segments" at column 12, line 39.

Zoom:

See Scale/Scaling above.

12. Claims 137, 153, 249 and 579 are rejected under 35 U.S.C. 102(e) as being anticipated by Sacks et al. (US 4,736,437 A).

Sacks discloses:

storing first image information (figure 1, numeral 16);

storing video camera image information (figure 1, numeral 20);

generating rotation information (figure 1, numeral 18); and

generating comparison information in response to the images and the rotation information (figure 1, numeral 24).

In general, Sacks discloses a pattern recognition/image comparison system, comprising:

generating input image information (figure 1, numeral 14);

storing reference image information (figure 1, numeral 16);

generating comparison information in response to the input and reference image information (figure 1, numeral 22).

Specifically, Sacks discloses a system (figure 1) comprising:

CIRCULAR SCAN INFORMATION:

The reference image is scanned in 360 degrees of rotation (figures 3 and 5). See, “the rotating reference memory” at column 8, line 37 and “scan line varying from zero through 360 degrees” at column 6, line 32.

COARSE/FINE REGISTRATION:

Sacks begins with a progressive coarse registration process ("coarse search" at column 7, line 50; this process is depicted in figure 2a) that proceeds in iterations (i.e., six (6) degree increments at column 7, line 31) as described above, followed by a fine registration process ("upon completion of the coarse search, a fine search is made" at column 8, line 4; this process is depicted in figure 2b) that also proceeds in similar iterations (i.e., two (2) degree increments at column 8, line 12) as already described.

The registration error generated by Sacks is pattern recognition error as the entire process of Sacks is a pattern recognition process, and the registration error is used to determine whether the input and reference patterns match thus resulting in a recognized pattern.

The registration error is a comparison error between the rotated reference image and the input image (i.e., see "compares" at column 6, line 40).

Sacks discloses an iterative process as depicted in figure 1, where registered image information is generated in response to previous comparison information in accumulator 24, if a threshold is not exceeded. Sacks also discloses a memory means (figure 1, numeral 28).

In summary, Sacks begins with a progressive coarse registration process "coarse search" at column 7, line 50: this process is depicted in figure 2a) that proceeds in iterations (i.e., six degree increments at column 7, line 31) followed by a fine registration process ("upon completion of the

coarse search, a fine search made" column 8, line 4; this process is depicted figure 2b) that also proceeds similar iterations (i.e., two degree increments at column 8, line 12).

COMPARISON/PATTERN RECOGNITION:

generating comparison information ("the total number of matches, which is a correlation number" at column 8, line 68; a correlation number is generated by convolver 22 in figure 1) by comparing in response to the second image information and in response to the rotated image information ("compares the video information from the scene being searched from the video memory 20 against the stored data from the reference memory 16" at column 6, line 40).

CONTROLLING A MACHINE/ROBOT:

Sacks discloses that the first image information (i.e., the image information for the "scene being searched" [column 6, line 42] stored in figure 1, numeral 20) is generated in response to information generated with an input sensor (figure 1, numeral 14; the sensor is a "video camera" at column 6, line 19) and controlling a machine in response to the comparison information ("supplies the positional information to the wire bonder which in turn performs the necessary bonding" at column 15, line 32).

CONTROL OF SENSOR DEVICE:

Sacks discloses that the first two dimensional memory mapped image information (i.e., the information stored in memory 20 of figure 1) is generated using a video camera ("video camera" at column 6, line 19) and controlling a sensing device in response to the comparison information (the comparison information, in the form of a "correlation number" at column 8, line 68, is used to determine whether a "match has been made" at column 10, line 58, whereby the "exact angle" of rotation at column 10, line 59 is provided to a "wire bonder" at column 15, line

32; the wire bonder is a sensing device, that senses areas on an IC chip that require bonding; see "supply this angle information to the wire bonder" at column 15, line 42, and "move the next chip in position" at column 15, line 54).

CORRELATION:

Sacks discloses a correlation processor ("convolver 22 ... to continuously correlate the information" at column 6, line 40).

FEEDBACK:

Error information is fed back to the process during the coarse and fine searches. The feedback loops are depicted in figure 1.

FIRST AND SECOND IMAGE INFORMATION:

generating first image information (figure 1, numeral 16; "loading reference data concerning a part under investigation from video input 14 through the CPU 10 and into a reference memory 16" at column 6, line 26);

generating second image information (figure 1, numeral 20; "video information from the scene under investigation is fed from the video input 14 to video memory 20" at column 6, line 36);

ITERATIVE/PROGRESSIVE:

Sacks generates new, rotated image information during each iteration in response to the registration error, the input and reference images as described above.

The Sacks process is a progressive process that proceeds in iterations. Each iteration comprises a rotation of the reference image, followed by a comparison of the input and rotated reference images, where the comparison error (i.e., registration error) is compared to a threshold. The process is progressively repeated in iterations until the threshold is exceeded and until a final registration coordinate is reached as depicted in figure 2b, by the dashed line.

Sacks begins with a progressive coarse registration process "coarse search" at column 7, line 50: this process is depicted in figure 2a) that proceeds in iterations (i.e., six degree increments at column 7, line 31) followed by a fine registration process ("upon completion of the coarse search, a fine search made" column 8, line 4; this process is depicted figure 2b) that also proceeds similar iterations (i.e., two degree increments at column 8, line 12).

The Sacks process is a progressive process that proceeds in iterations. Each iteration comprises a rotation of the reference image, followed by a comparison of the input and rotated reference images, where the comparison error (i.e., registration error) is compared to a threshold. The process progressively repeated in iterations until the threshold is exceeded and until a final registration coordinate is reached as depicted in figure 2b, by the dashed line.

MEMORY/64 PIXEL BLOCKS:

The first and second image that are stored in the memories 16 and 20 as depicted in figure 1 and described above are memory mapped (i.e., "represents individual bits of information in 4,096 positions of addressable memory" at column 10, line 64; the images are stored as an

array of "64 pixels by 64 pixels" at column 6, line 57; figure 3 depicts the array at numeral 50, where the actual memory is 128 X 128 pixels; thus, the pixels are mapped to specific locations in the memory array).

PATTERN RECOGNITION:

Sacks discloses generating pattern recognition information by recognizing a pattern in response to the second image information and the rotated image information (the Sacks system is a "pattern recognizer" as described at column 5, line 59, where a pattern is recognized based on the above described comparison between the second image information and the rotated first image information when a "match has been made" as described at column 10, line 58; the pattern recognition information generated is in the form of a "correlation number" as described at column 8, line 68, which is stored in the "accumulator" 24 in figure 1).

The entire process Sacks a pattern recognition process, and the registration error is used to determine whether the input and reference patterns match thus resulting in a recognized pattern.

RASTER SCAN:

Sacks inputs and processes video images that are raster scanned (see figures 4 and 5 and associated description).

REGISTRATION/REGISTRATION ERROR:

Sacks discloses:

generating input and storing reference image information (i.e., figure 1, numerals 20 and 16 respectively);

generating registration error information representing registration error between the input and reference image information ("convolved information" at column 6, line 44; this information is in the form of a "correlation number" at column 6, line 49; the correlation number indicates how many pixel of the rotated reference image match pixels of the input image) in response to registered image information (before the correlation information is calculated, the reference image is first rotated by an "arbitrary selected" amount at column 7, line 33; following this, a correlation number is calculated and compared to a threshold; if the threshold is not exceeded, the reference image is again rotated by another amount and the process repeated; eventually, the process rotates in a direction that causes the correlation number to approach the threshold as depicted in figure 2a; the process terminates when the threshold is exceeded as also depicted in figure 2a, where a fine search is performed as depicted in figure 2b; thus, during any given iteration of the above described process, the input and reference images are registered by first rotating the reference image, and then a correlation number is calculated; this meets the claimed requirements); and

generating registered image information by registering in response to the registration error information (as described immediately above, during one iteration of the repeating rotate and compare process, when the correlation number does not exceed the threshold depicted in figure 2a, the reference image is rotated at a different angle for another comparison; thus, a new set of registered image information is generated by registering via. reference image rotation in response to the previously generated registration error, or correlation number information), in

response to the input image information and in response to the reference image information (the process of rotation and generating registration error information is responsive to both the input and reference images as it is these images that are compared, once the reference image is rotated, to generate the registration error).

ROTATION:

generating rotated image information (figure 1, numeral 18; a rotated image is generated as depicted in figure 3, where image 50 is rotated to image 52; see "rotating the reference" at column 11, line 15) by mapping through a transform (image data is mapped from memory 16 to the convolver 22 according to a scanning angle; see "scanned from the reference area 50 at an angle defined by the rotated angle Theta" at column 11, line 18; the mapping takes place according to a coordinate transform as described at column 12, line s 50-55 and as depicted at figures 4-5; i.e., coordinates for scanning are transformed according to delta x and delta y values as depicted in figures 4 and 5) in response to the first image information (the rotation is responsive to the first, or reference image information as depicted in figure 1 by blocks 16 and 18); and

SUBPIXEL SEARCH INFORMATION:

A "best match can be calculated to an accuracy of +/- 0.1^{o}" at column 4, line 65.

UNDERSAMPLING:

"1/16TH of the video data at a time" at column 8, line 63; or

"sample pixel in every of 4 pixels it taken" at column 7, line 63.

WARP/WARPING:

Sacks rotates an image, and rotation is a form of warping.

13. Claim 105 is rejected under 35 U.S.C. 102(e) as being anticipated by Taylor et al. (US 4,563,703 A).

Taylor discloses:

storing image information on a disk drive (figure 6, numeral 23);

spatially interpolating the images (figures 7 and 8); and

temporally interpolating the images (figures 7 and 9).

Taylor also discloses a system for provide "special effects" (column 1, line 7) to "reconstitute a picture of different shape or size to that input to the store" (column 1, line 13), which is "capable of producing greater flexibility in picture manipulation whilst maintaining picture quality so that the resultant picture is not noticeably degraded" at column 1, line 20. Taylor's system comprises weighting (figure 3, numeral 20; "K" weights incoming pixels) and scaling (figure 3, numeral 38; the output of summer 38 includes a reduced size image, such as that depicted in figure 2c; e.g., "2:1 reduction in picture size" at column 3, line 26) using integral and fractional addresses (figure 3, numeral 12). Taylor's system is also capable of range variable processing (figure 5; "variable compression" at column 3, line 43).

An input circuit generating input image information is provided by Taylor by explicit reference to "input" video in at least Figs. 1 and 3-4. A computer memory storing computer

instructions is at least inherently provided by explicit reference to a "computer" as shown in at least Fig. 6, block 20, and as noted in c. 5, lines 1-60, since computers must operate based on instructions. A processor generating spatially interpolated image information by spatially interpolating in response to the input image information and in response to the computer instructions is provided by Taylor with reference to the output of the computer 20 in Fig. 6 to the interpolation block 12 in Fig. 6 and c. 5, lines 1-52 and c. 6, lines 1-40, the interpolation process of Taylor being a "processor". An output memory and a memory writing circuit writing output image information into the output memory in response to the spatially interpolated image information, the output memory storing the output image information is provided by writing interpolated information within memory based on addressing is taught by Taylor in at least the abstract, c. 4, lines 61-63, c. 5, lines 26-52, and see also c. 2, lines 8-27, the last full paragraph in c. 2, and the paragraph bridging cols. 3-4, and the output memory 11 in at least Figs. 1 and 3.

The image information of Taylor corresponds to 8 x 8 pixels (i.e. 64 samples) and as also shown in Fig. 7.

Taylor provides for temporal interpolation also, and a television camera is provided at the input of the system of Taylor as the input video in at least Figs. 1 and 3 for example, and television is explicitly provided in at least the first full paragraph in c. 1 of Taylor, so that television information is generated throughout the system of Taylor.

Taylor provides for temporal interpolation also, and where the image information of Taylor corresponds to 8 x 8 pixels (i.e. 64 samples) also shown in Fig. 7.

Taylor operates on video frames, e.g. the framestore block 11 in at least Figs. 1 and 3, and the plurality of frame image information shown in at least Fig. 7.

A plurality of blocks of 64 samples is also provided by Taylor as noted above, and as shown in Figs 2(a) – 2(d) showing a plurality of cells which are related to the blocks of 64 samples of Taylor.

Taylor discloses displaying an image in response to the 64-pixel block of image information is provided by Taylor in at least the first full paragraph in c. 1 and c. 6, lines 40-56, where the displaying is provided by television broadcast to televisions.

Occulting information is also provided by Taylor in at least c. 4, lines 50-60, where obscuring data information provides for occulting information if desired in the system of Taylor, and the addressing of Taylor is for addressing 64-pixel blocks where cited above.

14. Claims 115, 127 and 380 as well as the remaining pending claims are rejected under 35 U.S.C. § 102(e) as being anticipated by Tescher et al., 4,541,012.

Tescher discloses storing pixel image information in a memory is provided by Tescher by at least memory block 13 in Fig. 1 or also by reference memory 14 in Fig. 1.

Generating transformed image information in response to the image information stored in the memory and in response to feedback information is provided by Tescher by transformation block 20 in Fig. 1, which takes input from at least memories 13 and 14 in Fig. 1, and further takes feedback from coder 22 via distortion calculator 18 and block 16 in Fig. 1. This feedback informs the transformer block 20 to perform transformation as noted in the first full paragraph in c. 6, so that it is clear that the transformer provides for transformation based on feedback.

Generating the feedback information in response to the transformed image information is provided by the transformed image later being quantized in block 23 and coded in block 22 in Fig. 1 and then fed back to block 18 to control the transformation process.

The claim is also anticipated with respect to feedback by at least feedback to the transformer from memory 21 in Fig. 1.

For claim 127, storing prior pixel image information representing a prior image is provided by Tescher by image memory block 13 in Fig. 1 and as noted in the paragraph bridging cols. 5-6, which stores a previous image.

Storing next pixel image information representing a next image is also stored in the same memory block 13 in Fig. 1 as noted in the paragraph bridging cols. 5-6. Furthermore/alternatively, next pixel images are also provided by memory 14 in Fig. 1 and as noted in the first full paragraph in c. 6, where Tescher explicitly teaches updating the memory with new image information in the form of 64-pixel blocks.

Generating transformed image information in response to the prior pixel image information and in response to the next pixel image information is provided by the transformation block 20 in Fig. 1, which takes input from both memories 13 and 14, as clearly shown in Fig. 1.

For claim 115, storing prior and next pixel image information, the prior and next pixel image information representing a prior and next image is provided by the sequence of video images of Tescher in Fig. 2, blocks 21' and 13', which both provide for storing images of the video sequence as indicated in c. 10, lines 30-50.

Generating 64-pixel blocks of spatially interpolated image information in response to the prior and next pixel image information is provided by Tescher by block 12', which spatially interpolates back to the original blocks by interpolative processing in the paragraph bridging cols. 10-11, c. 11, lines 3-10, lines 46-51, and c. 12, lines 13-17.

For claim 380, memory means for storing pixel image information is provided by Tescher by at least block 13 in Fig. 1.

Means for generating weight information is provided by Tescher in at least the paragraph bridging cols. 5-6, where weight information is explicitly generated by specific circuitry depending whether the sample is prior or next.

Means for generating scale image information is provided by Tescher by scaling the video frame using subsampling by a scale factor of four as noted in the paragraph bridging cols. 10-11 and the chrominance components are also scaled down by averaging as noted in c. 11, lines 3-48.

Means for generating scaled weighted image information in response to the pixel image information stored in the memory means, in response to the scale factor information, and in response to the weight information is provided by Tescher where cited above, where not only is it clear that the scaling and weighting factors are generated (e.g. various fractions as explicitly disclosed), but that these factors for both scaling and weighting are used.

Tescher also discloses storing prior and next pixel image information representing a prior and next image is provided by Tescher by image memory block 13 in Fig. 1 and as noted in the paragraph bridging cols. 5-6, which stores a previous and next image. Furthermore/alternatively, next pixel images are also provided by memory 14 in Fig. 1 and as noted in the first full

paragraph in c. 6, where Tescher explicitly teaches updating the memory with new image information in the form of 64-pixel blocks.

Generating spatially interpolated image information in response to the prior pixel image information and in response to the next pixel image information is provided by Tescher by interpolation in at least the paragraph bridging cols. 10-11.

Tescher also discloses storing prior and next pixel image information representing a prior and next image is provided by Tescher by image memory block 13 in Fig. 1 and as noted in the paragraph bridging cols. 5-6, which stores a previous and next image. Furthermore/alternatively, next pixel images are also provided by memory 14 in Fig. 1 and as noted in the first full paragraph in c. 6, where Tescher explicitly teaches updating the memory with new image information in the form of 64-pixel blocks. Explicit reference to frames of image information is provided by Tescher in at least the paragraph bridging cols. 10-11.

Generating transformed image information in response to the frame of prior pixel image information and in response to the frame of next pixel image information is provided by transformation block 20 in Fig. 1 of Tescher.

15. Claims 113, 125, 127, 198, 223, 238 and 261 as well as the remaining pending claims are rejected under 35 U.S.C. § 102(b) as being anticipated by Jain et al. ("Displacement Measurement and Its Application in Interframe Image Coding", IEEE Transactions on Communications, vol. COM-29, No.12, December 1981).

Jain discloses storing prior and next pixel image information representing a prior and next image is provided by Jain by the frame memories in Figs. 6b and 9 on pages 1805 and 1807.

Generating temporally interpolated image information in response to the prior pixel image information and in response to the next pixel image information is provided by Jain by equations 24 and 25 on page 1803 and the accompanying text.

Generating transformed image information in response to the temporally interpolated image information, in response to the prior pixel image information, and in response to the next pixel image information is provided by transforming the motion compensated image by a 2-D DCT (i.e. Discrete Cosine Transform) in Figs. 6b and differentially by the 2-D DCT in Fig. 9.

Jain discloses a first and second memory for storing prior and next pixel image information representing a prior and next image is provided by Jain by the frame memories in Figs. 6b and 9 on pages 1805 and 1807 respectively, where both memories provide for storing image frames in sequence, so that both provide for storing prior and next image information.

A spatial interpolation circuit generating spatially interpolated image information in response to prior pixel image information and in response to next pixel image information is provided by Jain, because the interpolation of Jain is a spatial–temporal interpolation, since equations 24 and 25 on page 1803 and the accompanying text clearly reveal that the coordinates m and n are spatial coordinates of a particular block before and after spatial displacement. See also the first paragraph on page 1802, for the spatial displacement, and equations 7-9, which show that the motion compensation, which provides for interpolation noted above, also clearly calculates a spatial displacement of pixel information by using interpolation between prior and next frames.

A transform image processor coupled to the spatial interpolation circuit, the transform processor generating transformed image information in response to the spatially interpolated

image information generated by the spatial interpolation circuit, in response to the prior pixel image information, and in response to the next pixel image information is provided by transforming the motion compensated image by a 2-D DCT (i.e. Discrete Cosine Transform) in Figs. 6b and differentially by the 2-D DCT in Fig. 9 on pages 1805 and 1807 respectively.

For claim 113, storing a frame of prior and next pixel image information representing a prior and next image respectively is provided by Jain by the frame memories in Figs. 6b and 9 on pages 1805 and 1807 respectively, each memory storing prior and next frames in time, since the images are in a video sequence.

Generating subpixel change information having subpixel resolution by subtracting between the prior and next frames is provided by Jain by subtracting prior and next frames using the subtractor in Figs. 6b and 9 on pages 1805 and 1807 respectively, and alternatively by determining the positional change between the two frames (i.e. displacement) by finding a displacement vector as shown in Fig. 6b and 9 on pages 1805 and 1807 respectively, and further in the first full paragraph on page 1802, which provides for fractional, i.e. sub, pixel displacement, and subpixel resolution, since Jain teaches higher levels of accuracy using more pixels due to the addition of fractional pixels to the integer pixels, and can also interpolate between the displacements for higher accuracy, which appears to be in line with Applicant's specification for what Applicant regards subpixel.

Jain discloses a transform processor generating transformed image information in response to the prior and next pixel image information is provided by the 2-D DCT (i.e. discrete cosine transform) processor explicitly shown in Figs. 6b and 9 on pages 1805 and 1807

respectively, which clearly transforms in response to the displacement (i.e. subpixel vector change information) of Jain in the first full paragraph on page 1802.

Jain discloses a motion compensated image frame u^c, in Figs. 6b and 9 of Jain on pages 1805 and 1807 respectively, provides for delta subpixel image information, because the motion compensated image is an image that accounts for the delta positional displacement vector between frames. This is clearly shown in the figures, where a displacement vector is used to derive the motion compensated image between frames. Therefore, it should be clear that delta subpixel image information having subpixel resolution by subtracting in response to the pixel image information stored in the memory is provided by Jain.

Furthermore, generating this delta subpixel image information, which as noted above, can correspond to the motion compensated image of Jain, clearly also takes feedback as also explicitly shown in Figs. 6b and 9 of Jain on pages 1805 and 1807 from both feedback from the motion compensated image and also from feedback of an inverse transformed quantized error image. Thus, in response to the feedback information, and generating the feedback information in response to the delta subpixel image information is clearly provided by Jain.

A display product is provided by Jain in at least the first full paragraph of the Introduction on page 1799, where many such products are produced by the numerous applications listed, e.g. a television product image, a medical image, etc.

16. Claims 105, 106, 107, 108, 118, 119, 123, 124, 126, 135, 137, 143, 145, 148, 153, 157, 188, 189, 197, 201, 203, 204, 206, 212, 214, 215, 218, 228, 231, 249, 255, 264, 267, 388, 525, 527, 533, 535, 539, 553, 555, 557, 559, 561, 564, 573, 575, 578 and 580 are rejected under 35

U.S.C. 102(e) as being anticipated by Fant (US 4,835,532 A). The following is a description of the Fant reference as it is applied to the claims. Due to the large number of claims at issue, one claim will be exemplified, followed by an explanation of where the remaining claim features are disclosed by Fant.

EXAMPLE CLAIM - 189

A process comprising the acts of:

storing computer instructions

The entire system is computer controlled, and thus operates from stored computer programs. Each processing block shown in figure 3 has it's own sub-program. For example, see "programs are short for each process" at column 21, line 66, and "the FOV program" at column 27, line 25. Collectively, all of the sub-programs for each of the modules are a "computer program" as the entire system could not work without any one of them.

generating television image information; and

figure 13, "TV Camera";

generating zoomed image information.

Fant discloses displaying a moving 3D-perspective image simulating an observer roaming through an environment and zooming-in on features of interest in the environment to examine the features of interest in response to the display image information (col. 4, line 49-col. 5, line 31 and col. 14, line 57-col. 15, line 17). Fant explains that the helicopter simulator system provides continuous helicopter pilot eye-view image scenes corresponding to the gaming

area, wherein the gaming area includes a variety of features of interest (figure 12). Fant further explains that the system generates the continuous image scenes in response to controls (driving function) for guiding or navigating the helicopter in any direction in the gaming area. For instance, if the helicopter was operated to head towards a feature of interest such as the tank in figure 12, then the tank in each of the eye-view image scenes would zoom-in as the helicopter approaches it. Accordingly, the guidance of the helicopter simulator towards a feature of interest provides a zooming-in on the feature of interest, and allows the feature of interest to be examined in response to the display image information (eye-view scenes).

Likewise, Fant anticipates the other identified claims as described in the following discussion of the Fant reference.

Fant discloses:

"a computer controlled imaging system and, more particularly, to digital image processing system which has the ability to compose and construct a sequential stream of scenes for a display from a library of images with sufficient processing speed to permit real-time or near real time analysis of the images by a human operator or a hardware/software equivalent thereof" (column 1, line 13) "involving the use of real-world images in the data base" (column 3, line 10).

The Fant system:

- Is a simulator ("vehicle simulation such as an aircraft flight simulation" at column 1, line 22) for an

Aircraft ("aircraft" at column 1, line 23);

Helicopter ("helicopter" at column 1, line 31); and

Vehicle ("vehicle" at column 1, line 43);

- Receives "flight" navigation data and "terrain" data and produces "a simulated visual display as it would appear to an observer in the cockpit of the aircraft" (column 1, lines 27-29); and
- Provides a simulation flying through a 3D environment ("around and through the gaming area" at column 1, line 42; "pilot eye-view scenes in the gaming area corresponding to the location and attitude of the helicopter relative thereto" at column 4, line 58; "controls for guiding or navigating it in any direction in, around and through the gaming area in the manner of free flight" at column 4, line 61; "flight through a scene" at column 6, line 2; provides a window view on a display - "determines what is seen in the window, that is, the video display" at column 1, line 44).

System Overview

A brief overview of the Fant system as read by the examiner will be provided in relation to figure 3, which describes the overall system.

Data Base Construction Module: A database of object images and surfaces used for subsequent formation of the simulated environment is created off line. The images are captured from "models", "drawings", "slides" and "photographs" as well as other sources (figure 13 and

column 6, line 59). There captured by such input devices as a "TV camera", a "scanner", a "keyboard" and a "trackball" (figure 13) and include "not only the visual domain but also input/output based on sensed IR, MMW, radar, etc." (column 6, line 52). Once captured, the images are processed by "restoring edges, separating objects from their backgrounds, correcting intensity and color, generating realistic color, positioning object from system reference points, generating high-fidelity CGI objects, and generating graphic data" (column 6, line 64). Once processed, the object images are stored on a magnetic tape and optical disk (figure 13).

Vehicle Simulation Computation: The controls used by the operator to navigate the vehicle are input to this module, which in turn mathematically manipulates the data to provide the currently location of the observer. This module determines "locations and viewing direction of the visual or sensor system for the primary vehicle" as well as performing computations for "secondary vehicles based upon vehicle models and selected paths" (column 7, line 15).

Communications Subsystem: A cable or more sophisticated data link that links the subsequent image processing with the operator, providing a "bi-directional link and buffer interfacing the two systems" (column 7, line 26).

Field of View and Coordinate Transform Computations: This module inputs the operator's location and the location of objects in the Gaming Area Data Base and converts the real-world coordinates to screen coordinates, and determines what is currently in the field of view of the operator. A smart algorithm "tests only those objects or surfaces which are in the

proximity of the scene", "maintains a list of objects in the FOV and their object, surface or special-effect channel assignment", and determines "what can be seen by the observer" (column 7, line 40).

Gaming Area Database: This database provides "the information necessary for the placement of the contents of the object library, surfaces, and special effects on the grid or gaming area" (column 7, line 5) and "contains reference points for locating surfaces, objects and special effects" at column 9, line 63.

Object Controllers: Parallel object controllers "fan out" the subsequent processing of the objects, surfaces and special effects. The "processed control functions are passed to the object/surfaces/special effects processing channels" where the "main functions performed by the controllers include the transformation of the gaming area coordinates to screen coordinates, processing range data from the operator controlled vehicle to each object in the FOV, determining the intensity of each object based upon range and object identification, and commanding to the object library base fro the retrieval of the correct image data" (column 7, line 55). These controllers serve to "fan out FOV data and generate precise control data for the scene" (column 7, line 60).

Object Library Databases: Created by the off-line processing above, and contain all image data pertaining to objects, surfaces and special effects in the gaming area and thereby "provide the correct image upon command" (column 7, lines 63-68).

Object, Surface and Special Effects Processing Channels: Process one large or a few smaller objects at a time. These channels are parallel pipeline processors that affect individual objects by changing perspective, position, size, rotation, warp and intensity based on range data and object type (column 8, lines 1-21). A detailed depiction of the channel processors is depicted in figure 31.

Scene Construction: Takes the individual images from each processing channel, separates them from the background, assembles the scene by overlaying and occluding according to range data, and smoothes the edges. This module is responsible for 1) object channel combination, 2) scene value adjustment to accommodate scene-wide intensity corrections, and 3) smoothing boundaries (column 8, lines 25-50). A detailed depiction of the scene construction module is seen in figure 50.

Special Effects Insertion: Inserts translucent special effects such as smoke, fog, dust, etc. using a mask (column 8, lines 52-62).

The entire system is computer controlled, and thus operates from stored computer programs. Each processing block shown in figure 3 has it's own sub-program. For example, see "programs are short for each process" at column 21, line 66, and "the FOV program" at column 27, line 25. Collectively, all of the sub-programs for each of the modules are a "computer program" as the entire system could not work without any one of them.

The Hardware Processing Elements

The following bolded headings provide a more detailed description of each of the hardware processing elements of figure 3:

Off-Line: Database Construction:

The database of object images is generated off-line, using the system of figure 13. Images are captured, segmented, processed/restored, and saved for use as objects or special effects in the gaming area. Looking at figure 13, the image inputs include:

- Scene Models
  - Photographs
  - Slides
- Sensor Data
  - TV Camera
  - Drum Scanner
- Nodal Points for CGI Objects
  - Keyboard
  - Magnetic Tape
- Graphics Data
  - Keyboard
  - Trackball

The Image Processing System comprises:

A computer

Mass Storage

A Keyboard

A Track ball

Magnetic Tape.

The outputs include:

Video Tape

Optical Disk.

The system of figure 13 processes images off-line to build an object data base by "restoring edges, separating objects from their backgrounds, correcting intensity and color, generating realistic color, positioning object from system reference points, generating high-fidelity CGI objects, and generating graphic data, i.e., light sources" at column 6, lines 61-65. Also see, "edges are restored, the background is separated from the objects, intensity and color are corrected, realistic color is generated, objects are positioned for system reference points ... CGI objects are generated, and graphics data (light sources) are generated" at column 9, lines 53-59.

For example, referring to figure 15, a "texture" image is photographed, digitized, axis changed, luminance corrected, color corrected, windowed, transferred to tape and then to an optical disk.

For another example, refer to figure 16 where a tree is photographed, retouched for a uniform background and ground contact, digitized, edge restored, luminance corrected, color corrected, stored in a tape and then on an optical disk.

Additional processing includes adding "ground contact and height reference points" at column 6, line 66.

The database stores 2D and 3D objects:

Regarding 2D Objects:

A "picture is taken of the objects from the average aspect angle used in the desired simulation" at column 10, line 44.

"a single picture may be stored on a track of the optical disk and processed through a warp operation to obtain the proper rotation, size and position" at column 10, line 57.

Regarding 3D Objects:

"during a flyover, the perspective changes by 90 degrees ... simulation may require a series of additional pictures in the vertical axis" at column 10, line 63.

"a series of pictures in as small as 1-degree increments in both azimuth and elevation" at column 11, line 1.

"rotating models of large objects ... photographing the objects at each setting" at column 11, line 7.

"breaking the objects down into subsurfaces" at column 11, line 10.

Other features of the database construction include:

"real objects and simulated special effects" at column 13, line 5.

"IR, visual, millimeter wave, radar, ... loaded in the object file" at column 13, line 11.

The imagery "simulates the sensor because it comes from the sensor" at column 13, line 13.

"parameters of the images or sensor may be modified when building the library or in the setting of intensity values during real-time processing" at column 13, line 15.

A IR example is seen in figure 13.

Vehicle Simulation Computations/Operator Input:

The vehicle simulation computation modules accepts all operator commends (i.e., the pilot's controls), processes them using a math model that simulates the vehicle, and outputs the viewing location and viewing directions of the vehicle. Features of this module include:

Operator Commands:

Navigational information is generated and input to this module. See:

"controls for guiding or navigating it in any direction in, around and through the gaming area in the manner of free flight" at column 4, line 61.

"controls by a pilot trainee would define the dynamic movement of the helicopter" at column 5, line 3.

Functions of the Module:

"based upon the vehicle math model and control inputs" at column 7, line 14.

"determine the locations and viewing directions of the visual or sensor system for the primary vehicle" at column 7, line 16.

"secondary vehicles" at column 7, line 18.

The "output of this determines the location of the observer" at column 7, line 19.

The "X,Y,Z, roll, pitch and yaw signals indicating instantaneous locations of such vehicles" at column 16, line 8.

Communications Subsystem/Data Link:

This system interfaces the operator with the simulation system; it provides I/O as well as buffering. See:

"the input/output or I/O of the vehicle simulation system" at column 7, line 23.

"bi-directional link and buffer interfacing the two systems" at column 7, line 26.

"converts the digital output signal from the vehicle simulation computer to match the input to the ... FOV computer" at column 16, line 21.

"cable" or "buffers and microprocessors" at column 16, line 23.

Gaming Area Data Base:

The gaming database provides object placement information for gaming area set-up. See:

"provided the information necessary for the placement of the contents of the object library, surfaces, and special effects on the grid or gaming area" at column 7, line 5.

Object placement in the gaming area can be "manual" (i.e., done by an operator) or "automatic" at column 7, lines 6-10.

"contains reference points for locating surfaces, objects and special effects" at column 9, line 63.

Gaming area set-up: "manual mode or an automatic mode" at column 9, line 64.

Manual:

Operator "may search the object library and select which objects to place in the gaming area" at column 9, line 67.

Operator "selects an X,Y,Z surface reference point ... horizontal, vertical and range axes" at column 10, line 4.

"reference point determines height and position" at column 10, line 7.

Automatic:

"computer processes and places the objects" at column 10, line23.

Field of View Coordinate Transform Computations:

This processor determines what is be seen by the observer and converts real-world to screen coordinates. See:

"determines the presence of objects, surfaces, and special effects in the scene under construction" at column 7, line 33.

"converts real-world coordinates to screen coordinates" at column 7, line 35.

"maintains a list of objects in the FOV and their object, surface or special-effect channel assignment" at column 7, line 42.

"determine what can be seen by the observer" at column 7, line 45.

Figure 28.

Two types of vehicle simulation computations:

1. "position vectors which define the changing position of the aircraft relative to the origin" at column 16, line 42.

2. rotational data (yaw, pitch and roll) which defines the changing attitudes of the aircraft" at column 16, line 45.

See figure 29 for equations.

"yield distance or range of any object or surface" at column 16, line 51.

Disk access for object images at column 16, line 66.

Object image size "512 lines having 512 pixels per line" at column 17, line 1.

"FOV processor uses the height in the transform equations ... to determine corresponding screen coordinates" at column 17, line 14.

"linear warp algorithm ... mapping of the image from the input frame 25 to the screen frame 26" at column 17, line 19.

Results of FOV processing:

1. "determination of osse's in the field of view" at column 17, line 24.

2. "distance of each OSSE from the location of the observer" at column 17, line 25.

3. "the screen coordinates of the four vertices to the enclosed space of which the input image of each OSSE is to be mapped" at column 17, line 27.

Object, Surface, Special Effects Controllers:

These controllers serve to control the flow of data and sequence of processing related to the object library data bases and the processing channels. See:

"'fan-out' FOV data ad generate precise control data for the scene" at column 7, line 61.

"transformation of gaming area coordinates to screen coordinates" at column 7, line 54.

"process range data from the operator controlled vehicle to each object in the FOV" at column 7, line 55.

"determine the intensity of each object based on range and object identifications" at column 7, line 57.

"commanding the object library base for the retrieval of the correct image data" at column 7 line 58.

"controllers command the selected images which are passed to the processing channels" at column 7, line 64.

Sends transformation control to image processors ("transformation specified by the control functions" at column 8, line 13.

Object Library Data Base:

Stores the images created by the off line data base construction referred to above. Analog or digital image data are stored on optical disks at column 9, lines 9-12. See:

"stores the image used to construct a scene" at column 7, line 64.

"images of objects and surfaces" at column 6, line 47.

"rocks, trees, bushes, shrubs, etc." at column 10, line 42.

"bushes, trees, surfaces, mountains, roads, lakes, or groups of small objects on one file" at column 10, line 1.

"transmissivity masks of special effects at column 6, line 48.

I/O based on IR or Radar at column 6, line 51.

"2D and 2D images" at column 6, line 53.

"three dimensional multi-image objects may be stored in a series of images which represent 1-degree increments both azimuth and elevation" at column 10, line 15.

"day/night and diurnal conditions" at column 6, line 54.

"photographic matter" at column 6, line 56.

"models, artist drawings, photographs" at column 6, line 59.

"Optical disks" at column 9, line 3.

"disk controller, disk drive, signal conditioning module and optical disk" at column 9, line 9.

"analog" or "digital disk" at column 9, line 11.

"6 to 8 bits, or 64 to 256 gray shades" at column 9, line 12.

"up to 12-bit data" at column 9, line 14.

"525-line" at column 9, line 15.

Stores an upright or a rotated version of the image at column 9, lines 25-30.

"54,000 frames", "12-inch disk", "60 cycle field time", read only" at column 9, lines 40-50.

"divided to three basic classes, namely objects, surfaces and special effects" at column 10, line 31. "further classified into two-dimensional, three-dimensional one axis, three-dimensional two axis, and light sources" at column 10, line 33.

For 2D, "a single picture may be stored on a track of the optical disk" at column 10, line 57.

"classification '2D Natural Objects' includes trees, bushes, and small rocks" at column 13, line 35.

"man-made objects have definite orientations such as the front or side of a vehicle" at column 13, line 53.

"clumps of small patches may be warped and laid out to form a continuous high texture large surface" at column 13, line 67. "collection of many small patches" at column 14, line 2. "water, rocks, roads, railroad tracks, etc." at column 14, line 10. "patches can have dynamic motion ... wind or rotor blast" at column 14, line 12. "storing a series of dynamic frames on the optical disk and feeding the frames through the surface processors" at column 13, line 15.

"2D surfaces" at column 14, line 24.

"2D Multisurfaces" at column 14, line 40.

For 3D, "simulation may require a series of additional pictures in the vertical axis" at column 10, line 63.

For 3D, "a series of pictures in as small as 1-degree increments in both azimuth and elevation" at column 11, line 1.

"3D Multi-View" at column 14, line 57.

3D object creation of "multisurfaces" at column 14, lines 40-56.

"light sources are laid out from a string of points stored in memory and a warp algorithm warps the surface from a normal view to the vehicle perspective" at column 11, line 30.

"the data base has a list of all the objects, surfaces and special effects" at column 17, line 3. "the data base contains information regarding the height of each object therein" at column 17, line 8.

Object, Surface, Special Effect Processing Channels:

These channels are under control of the controllers, and process the data retrieved from the object library data bases. See:

"pipeline processors" at column 8, line 3.

Can process "one large item" or "a plurality of smaller items in parallel" at column 8, lines 3-7.

"change a stored image in normal straight-on perspective to scene conditions ... by changing image, position, size, rotation, and warp" at column 8, line 17.

"image intensity is modified" at column 8, line 18.

"as the elevation changes, the object is transformed between reference points which results in an increased or decreased height, depending upon the perspective" at column 10, line 48.

"... size and size changes, provide depth cues" at column 10, line 54.

"a single picture may be stored on a track of the optical disk and processed through a warp operation to obtain the proper rotation, size and position" at column 10, line 57.

"during a flyover, the perspective changes by 90 degrees ... simulation may require a series of additional pictures in the vertical axis" at column 10, line 63.

"display in various perspective views in a sequence of scenes" at column 11, line 14.

"light sources are laid out from a string of points stored in memory and a warp algorithm warps the surface from a normal view to the vehicle perspective" at column 11, line 30.

"clumps of small patches may be warped and layed out to form a continuous high texture large surface" at column 13, line 67. "collection of many small patches" at column 14, line 2. "water, rocks, roads, railroad tracks, etc." at column 14, line 10. "patches can have dynamic motion ... wind or rotor blast" at column 14, line 12. "storing a series of dynamic frames on the optical disk and feeding the frames through the surface processors" at column 13, line 15.

"textured imagery may be warped to produce textured surfaces" at column 14, line 26. "Linear warping may by used on near square 'objects', but true perspective warp should be used for realistic representation of long narrow 'objects'" at column 14, line 30.

3D object creation of "multisurfaces" at column 14, lines 40-56.

Figure 23, and column 15, lines 1-15 – "frames ... indexed on the disk in 1-degree increments from 0 to 90 degrees in elevation, for each 1-degree incremental change in azimuth" at column 15, line 3.

Detailed in Figure 31:

Parallel Processors: "identical channel hardware is suitable for all three functions" at column 17, line 37.

"obtain the correct intensity, color, image, size, location, rotation and perspective ..." at column 17, line 43.

A/D converter – "512 pixels per line, 480 active lines (525 total) and eight bits per pixel (256 gray shades)" at column 17, line 49.

"high-speed memory card", "loading depends on the rotation of the image", "minimize pixel compression" at column 17, lines 51-56.

"lookup table or lut 34 modifies the intensity values of images for range and contrast effects" at column 17, line 64.

"warp card 36 transforms the image in the Y axis on a line-by-line basis" at column 17, line 68; "magnification factors shift and compress or expand the pixels of each line" at column 18, line 2.

"second ... memory" at column 18, line 5.

"second warp card ... processes X axis data" at column 18, line 10.

Intensity Control:

"maps input intensity values into output intensity values via the data stored in the LUT" at column 18, line 23.

Intensity correction for "specific objects" or the "entire scene" at column 18, lines 30-34.

"memory controller" at column 18, line 35.

Linear Warping:

"spatial transforms on a digital image represented as a matrix of intensity values" at column 18, line 44.

Figure 30 – multiple pass as described at column 18, lines 45-57.

"linearly interpolates each input line to a different size and position in the output image" at column 18, line 51. "size and position parameter for each interpolation are determined from the input image corner coordinates and the output corner coordinates" at column 18, line 54. "interpolation consumes consecutive input pixels and generates consecutive output pixels" at column 18, line 56. "two passes" at column 18, line 58.

"each pass simply sizes (enlarges or reduces) the input line and position (offset) it in the output video image" and "both of these operations are accomplished by continuous interpolation over the discrete field of pixels" at column 19, line 1; "continuous line sizing and subpixel positioning of output lines and columns which completely eliminate aliasing of diagonal edges" at column 19, line 3.

Warping:

Column 21, lines 4+.

Scene Construction:

This module integrates all the objects belonging to a scene by overlaying and warping. Refer to figures 4-12 were objects are overlaid on a background as well as each other, whereby near objects occlude farther objects. This module is detailed in figure 50. First, the various object channels are combined based on the images and information from the controllers. Then, the scene values are adjusted. Finally, a smoothing algorithm is applied.

Input: "individual images from each processing channel' at column 8, line 25; "video inputs" at column 8, line 40.

Combining: Overlaying and Occulting. "near object occlude more distant objects" at column 8, line 28.

Scene Value Adjustment: "scene-wide intensity corrections" at column 8, line 48.

Smoothing: "high-frequency edges ... may be smoothed" at column 8, line 28; "to compensate for object-to-object and object-to-background boundaries" at column 8, line 49.

Uses Kernel Filtering: "edge smoothing algorithms may be used, a two-to-eight pixel process using Gaussian pixel weighting is preferred" at column 30, line 67.

Output: "special effects insertion module" at column 8, line 43.

Also see:

"separates the image from the background" at column 8, line 26;

"assembles the scene based upon range" at column 8, line 28.

"near objects occlude more distant objects" at column 8, line 28.

"smooth" the "high-frequency edges" at column 8, line 29.

"Gaussian function" at column 8, line 31.

"receives range information from the object an surface controllers" at column 8, line 33.

"determine whether or not a particular object is in front of, or behind, other objects in the scene" at column 8, line 35.

"accept video inputs" and "outputs may be real-time video signals" at column 8, line 43.

Provides:

"object channel combination" at column 8, line 46;

"scene value adjustment ... intensity corrections" at column 8, line 47;

"smoothing ... boundaries" at column 8, line 49.

"display in various perspective views in a sequence of scenes" at column 11, line 14.

"scene construction module uses range data to select each pixel in the final scene" at column 15, line 33. Figures 24-27.

Special Effects Insertion:

This module adds special effects to the constructed scene. See:

Adds "translucent special effects" at column 8, line 53.

"based upon range" at column 8, line 55.

"smoke, or dust, may occur ahead of, or behind images in the scene" at column 8, line 56.

"clouds, dust, smoke, fog and haze configurations" at column 11, line 67.

"typically treaded as 2D objects" at column 12, line 1.

Uses stored "intensity masks" at column 8, line 57.

"control the transmissivity of the special effects" at column 8, line 58.

"intensity value input controls the intensity/color of the special effects such as black smoke and white clouds" at column 8, line 60.

"translucent objects or images add further realism ... smoke, fog, dust, shadows, and haze" at column 11, line 38.

Method of Operation:

"smoke, fog, dust, shadow" objects "may be stored in a mask which defines the outline, shape and transmissivity factor" at column 11, line 39.

The "mask determines the combining percent of object and special effects" at column 11, line 41.

"A second variable controls the intensity or color of the special-effect object" at column 11, line 42.

"The mask determines the mixing ratio of the special effect with the background fixed variable-control intervals" at column 11, line 44.

"generate dust clouds rolling up behind a moving tank" at column 11, line 47.

"a warp operation may also be applied to distort the special effect and a series of sequential frames used to generate the motion" at column 11, line 48.

Special effects can be "static or dynamic" at column 11, line 51.

Dust on Moving Tank:

Referring to figure 17, a background image and a mask are combined as follows:

Output Pixel = Background + Mask(Special Effect Value – Background)

Output Pixel = (1-mask value) x (background) + (mask value) x (special effects value)

At column 11, line 59.

Special effects can be drawn "on white paper using gray tone markers" at column 11, line 64.

Dynamic Smoke:

Figure 18.

Generate "series of frames" at column 12, line 12.

"each pixel may be incremented one or more pixels in the Y axis when frames are played back to produce a continuous circulatory loop" at column 12, line 13.

The top of smoke cloud "is feathered" at column 12, line 16.

"warp function … used to expand the top to simulate diffusion" at column 12, line 20.

"shear the image to accommodate wind velocity" at column 12, line 22.

"size the cloud based upon range" at column 12, line 22.

"position the cloud in the scene" at column 12, line 23.

"initial condition parameter sets the color or intensity of the cloud" at column 12, line 24.

"rate" of playback determines "rate of flow" at column 12, line 25.

Dynamic Dust:

Figure 19.

"five to ten dust transmission masks may be created" at column 12, line 30.

"A series of linear interpolations between the various masks ... produce a series of frames which are stored in a video disk" at column 12, line 32.

"warp function ... places the mask in the correct perspective, size and position in the scene" at column 12, line 34.

"initial condition determines color and intensity" at column 12, line 36.

Shadows:

Figure 20

Shadows are "translucent objects" at column 12, line 40.

Generate "transmission mask" from "images in the object library" at column 12, line 42.

"setting all the pixels in an object o one gray level which determines the transmission of the shadow" at column 12, line 44.

Project the "four reference points of an object ... to the surface" at column 12, line 46.

Warp the shadow transmission mask "to fit the scene based upon the shadow's reference points" at column 12, line 49.

Combine the shadow and original object image as seen in figure 20.

Glint and Glare:

"a sector mask is developed based upon the glint and glare bright areas produced by different sun angles" at column 12, line 58.

Figure 21.

"the sectors in the mask are gray levels" at column 12, line 60.

"the sun angle table data sets the look-up tables on the object processor" at column 12, line 63.

"look up table sets the output glint and glare values to a predetermined level" at column 12, line 66.

"remaining output in the look up table are zero" at column 12, line 67.

E.G., "bright spot in sector 2" and "as the turret moves or the sun moves, the sector changes" at column 12, line 68.

A display (figure 3, "display"):

Displays the final constructed scene to the operator. For example, refer to figure 1. See:

"video display simulating a window in the cabin of the helicopter simulator" at column 4, line 68.

"video display would be in accordance with the instant-to-instant location of the helicopter" at column 5, line 4.

Three dimensional perspective images are displayed: See "display in various perspective views in a sequence of scenes" at column 11, line 14.

The Image Processing

The various types of data and images as well as the image processing operations disclosed by Fant are as follows:

Aliasing/Anti-Aliasing (construed above):

Performed in the "processing channels" depicted in detail at figure 31. Anti-aliasing is accomplished through the subpixel interpolation algorithm that is part of the warping process. See, "each pass simply sizes (enlarges or reduces) the input line and position (offset) it in the output video image" and "both of these operations are accomplished by continuous interpolation over the discrete field of pixels" at column 19, line 1; "continuous line sizing and subpixel positioning of output lines and columns which completely eliminate aliasing of diagonal edges" at column 19, line 3.

Altitude:

See Elevation.

Analog/Digital Converter:

Data from the "object library" optical disk when received by the processing channels is A/D converted at figure 31, numeral 30.

Artificial Intelligence (construed above):

Artificial intelligence decisions are made at almost every functional block of the Fant system, as each block is programmed to make decisions about how the gaming area is to be composed. For example:

The FOV processor "determines if all or any portion of the objects, surfaces and special effects are present in the scene", and from that "determines what can be seen by the observer" at column 7, lines 35-45.

Many other such examples of artificial intelligence can be found throughout the Fant disclosure.

Associative Database (construed above):

See Database

Architecture Product/Information:

Computer aided design information (e.g., the divided objects in figure 14) and used to build an architecture product (figure 14, the "object reconstructed").

Azimuth:

See Elevation

Background Images:

Many examples of background images are found throughout the Fant reference. For example:

- "sky is added in segments over a distant background" at column 5, line 32.
- In the Special Effects Processor, "the mask determines the mixing ratio of the special effect with the background fixed variable-control intervals" at column 11, line 44.

  Output Pixel = (1-mask value) x (background) + (mask value) x (special effects value) at column 11, line 59.

Boundary Processing/Smoothing:

- The "scene construction" module assembles the individual objects, and then performs "smoothing to compensate for object-to-object and object-to-background boundaries" at column 8, line 48. Refer to figure 50. The smoothing unit simulates "edge characteristics of the sensor" and "several different types of edge smoothing algorithms may be used [including] a two-to-eight pixel process using Gaussian pixel weighting" at column 30, lines 60-68.
- Also refer to "smoothing ... boundaries" at column 8, line 49.

Color Images:

The database images are color images. Fant generates, process and displays color images. For example, refer to:

- "correcting ... color, generating realistic color" at column 6, line 63.
- "intensity value input controls the intensity/color of the special effects such as black smoke and white clouds" at column 8, line 60.
- "color are corrected, realistic color is generated" at column 9, line 36.
- "initial condition parameter sets the color or intensity of the cloud" at column 12, line 24.
- "initial condition determines color and intensity" at column 12, line 36.
- "obtain the correct intensity, color, image, size, location, rotation and perspective ..." at column 17, line 43.

<u>Combine/Composite Images</u>:

Fant combines images and creates composite images to build a gaming area scene. For example, refer to:

- "object channel combination" at column 8, line 46;
- Adds "translucent special effects" at column 8, line 53.
- Uses stored "intensity masks" at column 8, line 57.
- "during a flyover, the perspective changes by 90 degrees ... simulation may require a series of additional pictures in the vertical axis" at column 10, line 63.
- "display in various perspective views in a sequence of scenes" at column 11, line 14.
- Special Effects Processor: The "mask determines the combining percent of object and special effects" at column 11, line 41. "A second variable controls the intensity or color

of the special-effect object" at column 11, line 42. "The mask determines the mixing ratio of the special effect with the background fixed variable-control intervals" at column 11, line 44. "generate dust clouds rolling up behind a moving tank" at column 11, line 47. "a warp operation may also be applied to distort the special effect and a series of sequential frames used to generate the motion" at column 11, line 48. Special effects can be "static or dynamic" at column 11, line 51. Output Pixel = (1-mask value) x (background) + (mask value) x (special effects value) at column 11, line 59.

- Combine the shadow and original object image as seen in figure 20.
- "clumps of small patches may be warped and layed out to form a continuous high texture large surface" at column 13, line 67. "collection of many small patches" at column 14, line 2. "water, rocks, roads, railroad tracks, etc." at column 14, line 10. "patches can have dynamic motion … wind or rotor blast" at column 14, line 12. "storing a series of dynamic frames on the optical disk and feeding the frames through the surface processors" at column 13, line 15.
- Figure 23, azimuth and elevation images are sequenced through to create 3D.

<u>Communications Link</u>:

See Data Link.

<u>Comparison Information:</u>

Fant generates comparison information during the image processing at several processing blocks. For example, refer to figures 35 and 36.

Computer Aided Design:

Computer aided design information (e.g., the divided objects in figure 14) and used to build an architecture product (figure 14, the "object reconstructed").

Computer Program/Computer Instructions:

The entire system is computer controlled, and thus operates from stored computer programs. Each processing block shown in figure 3 has it's own sub-program. For example, see "programs are short for each process" at column 21, line 66, and "the FOV program" at column 27, line 25. Collectively, all of the sub-programs for each of the modules are a "computer program" as the entire system could not work without any one of them.

Cropping/Cropped/Irregular Cropped:

Fant discloses cropping images in many ways in order to build the gaming area scene. For example, refer to:

- "Breaking the sky into segments, allows peaks and valleys to form the skyline as shown" at column 4, line 32.
- "may be curved or jagged to simulate rolling or sharp hills or mountains" at column 5, line 37.
- "Holes or windows in them ... a clearing in the branches to the next object" at column 15, line 28.
- The top of smoke cloud "is feathered" at column 12, line 16.

- During database construction, the captured images are processed by "separating objects from their backgrounds" at column 6, line 62. Given that most objects (e.g., tanks, trees, people, etc.) are not of a regular form, and then the backgrounds must be removed, or cropped irregularly.

For one specific example of many, Fant discloses generating a plurality of frames of image information (Figure 20, the "object" image (i.e., the tree)); generating a plurality of frames of irregular cropping information (Figure 20, the "transmission mask" image. This image will become the shadow, and will require cropping); and generating a plurality of frames of irregularly cropped image information in response to the image and cropping information (Figure 20, the "shadows combined" image. The shadow is cropped so that it is partially occluded behind the tree. The process is repeated for a plurality of other objects in the gaming area that require shadows).

Data Link/Communications Link:

Referring to figure 3, each of the various processing elements is linked to the other via. a data link of some type. One specific data link is described in detail: The "communications subsystem" at figure 3, that "converts the digital output signal from the vehicle simulation computer to match the input to the … FOV computer" at column 16, line 21, which can include a simple "cable" or more sophisticated "buffers and microprocessors" at column 16, line 23.

Database/ Database Images/Searching Database Images (construed above):

Fant discloses object, surface and special effects databases that hold all types of images. For example, refer to:

- Land, water, sky, trees, rocks, bushes, houses, roads, lights, vehicles, helicopters, airplanes, animals, girls, smoke, dust, clouds, shadows at column 5, lines 22-29.
- Streams or ponds at column 5, line 54.
- Tanks or ships at column 5, line 65.
- "rocks, trees, bushes, shrubs, etc." at column 10, line 42.
- Adds "translucent special effects" at column 8, line 53.
- Uses stored "intensity masks" at column 8, line 57.
- "bushes, trees, surfaces, mountains, roads, lakes, or groups of small objects on one file" at column 10, line 1.
- Operator "may search the object library and select which objects to place in the gaming area" at column 9, line 67.
- "divided to three basic classes, namely objects, surfaces and special effects" at column 10, line 31. "further classified into two-dimensional, three-dimensional one axis, three-dimensional two axis, and light sources" at column 10, line 33.
- "during a flyover, the perspective changes by 90 degrees ... simulation may require a series of additional pictures in the vertical axis" at column 10, line 63.
- "a series of pictures in as small as 1-degree increments in both azimuth and elevation" at column 11, line 1.
- "A series of linear interpolations between the various masks ... produce a series of frames which are stored in a video disk" at column 12, line 32.

- Figure 23, and column 15, lines 1-15 – "frames … indexed on the disk in 1-degree increments from 0 to 90 degrees in elevation, for each 1-degree incremental change in azimuth" at column 15, line 3.
- Disk access for object images at column 16, line 66. Object image size "512 lines having 512 pixels per line" at column 17, line 1.

ASSOCIATIVE AND RELATIONAL:

Associative Database: A database storing a set of "Items" and a set of "Links" that connect them together.

Relational Database: A database accessed and organized according to the relationships between data items.

Fant's object library database meets both broad criteria: That is, "the data base has a list of all the objects, surfaces and special effects" at column 17, line 3. "the data base contains information regarding the height of each object therein" at column 17, line 8. In addition, it is "divided to three basic classes, namely objects, surfaces and special effects" at column 10, line 31, and "further classified into two-dimensional, three-dimensional one axis, three-dimensional two axis, and light sources" at column 10, line 33.

Demultiplexing (construed above):

See Multiplexing below.

Detail Reduction:

See Reduce Detail below.

Disk Drive:

Fant discloses disk drives for data storage. For example, refer to:

- "Optical disks" at column 9, line 3.
- "disk controller, disk drive, signal conditioning module and optical disk" at column 9, line 9.
- "analog" or "digital disk" at column 9, line 11.

Distance:

See Range

DVD:

Fant discloses a "disk drive", where the disk is an "optical disk", and a "digital disk" at column 9, lines 9-11.

Educational Images/Learning Material:

Fant's images are related to simulation, and simulation (e.g., flight simulation) is for the purpose of training, or educating a pilot.

Elevation Data:

Fant discloses the generation and use of elevation data. For example, refer to:

- "individual segments are warped based on minimum and maximum data based elevations and upon viewpoint" at column 5, line 40.
- "ground contact and height reference points are added" at column 6, line 66.
- "change by the height of the object" at column 10, line 10.
- 3D objects are defined by "reference points which represent the center ground contact point, the center height, and a directional vector or pointing angle" at column 10, line 20.
- "as the elevation changes, the object is transformed between reference points which results in an increased or decreased height, depending upon the perspective" at column 10, line 48.
- "during a flyover, the perspective changes by 90 degrees … simulation may require a series of additional pictures in the vertical axis" at column 10, line 63.
- "a series of pictures in as small as 1-degree increments in both azimuth and elevation" at column 11, line 1.
- Figure 23, and column 15, lines 1-15 – "frames … indexed on the disk in 1-degree increments from 0 to 90 degrees in elevation, for each 1-degree incremental change in azimuth" at column 15, line 3.
- "the data base has a list of all the objects, surfaces and special effects" at column 17, line 3. "the data base contains information regarding the height of each object therein" at column 17, line 8.
- "FOV processor uses the height in the transform equations … to determine corresponding screen coordinates" at column 17, line 14.

<u>Expansion/Compression – Spatial (construed above)</u>:

Fant compresses and expands images spatially. For example, refer to:

- "objects may be expanded so that an object may be larger that the entire surface of the screen" at column 6, line 20.
- "as the elevation changes, the object is transformed between reference points which results in an increased or decreased height, depending upon the perspective" at column 10, line 48.
- "warp function … used to expand the top to simulate diffusion" at column 12, line 20.
- "compress or expand the pixels" at column 18, line 1.

<u>Feathering</u>:

The top of smoke cloud "is feathered" at column 12, line 16.

<u>Filtering/Low-Pass Filtering/Smoothing/Kernel Filtering</u>:

Fant discloses filtering images to smooth edges and boundaries. For example, refer to:

- "smooth transition from object to background" at column 5, line 13.
- "restoring edges, separating objects from their backgrounds, correcting intensity and color, generating realistic color …" at column 6, line 61.
- "image intensity is modified" at column 8, line 18.
- "smooth" the "high-frequency edges" at column 8, line 29.
- "Gaussian function" at column 8, line 31.
- "scene value adjustment … intensity corrections" at column 8, line 47;

- "smoothing ... boundaries" at column 8, line 49.
- "edges are restored" at column 9, line 54.
- A kernel filter is used in the smoothing unit. See, "edge smoothing algorithms may be used, a two-to-eight pixel process using Gaussian pixel weighting is preferred" at column 30, line 67.

Foreground:

Fant discloses generating and processing foreground image information. Fore example, see "to form foreground and foothill surfaces" at column 5, line 43.

Frequency Reduction:

See Reduced Frequency below.

Graphical Altitude Information (construed above):

See Terrain Altitude Information below.

Referring to figures 4-12, graphic objects are overlaid on a background as well as each other, whereby near objects occlude farther objects. For example, this is clearly seen in figures 10 and 11, where the trees are overlaid and therefore occult background objects. Overlaid graphical information includes altitude information. For example, "sky is added in segments over a distant background" at column 5, line 32. In addition, other graphical objects such as "helicopters" and "airplanes" are overlaid on the sky and background at column 5, line 26. Sky,

helicopters and airplanes are placed in accordance with altitude, as they are elevated above the ground surface. See "based on elevations" at column 5, line 40.

Graphics Information:

"CGI objects are generated, graphics data ... are generated" at column 9, line 59.

Infrared – IR:

See sensors.

Intensity/Image Format/Intensity Processing:

Fant's images have intensity, as well as formats. For example, refer to:

- "intensity of each surface may be varied based upon range or other desired parameters" at column 5, line 48.
- "correcting intensity" at column 6, line 62.
- "image intensity is modified" at column 8, line 18.
- "smooth" the "high-frequency edges" at column 8, line 29.
- "scene value adjustment ... intensity corrections" at column 8, line 47;
- "smoothing ... boundaries" at column 8, line 49.
- Uses stored "intensity masks" at column 8, line 57.
- "intensity value input controls the intensity/color of the special effects such as black smoke and white clouds" at column 8, line 60.
- "6 to 8 bits, or 64 to 256 gray shades" at column 9, line 12.

- "up to 12-bit data" at column 9, line 14.
- "525-line" at column 9, line 15.
- Interlaced at "60 cycle field time" at column 9, line 45.
- "A second variable controls the intensity or color of the special-effect object" at column 11, line 42.
- "initial condition parameter sets the color or intensity of the cloud" at column 12, line 24.
- "initial condition determines color and intensity" at column 12, line 36.
- "setting all the pixels in an object o one gray level which determines the transmission of the shadow" at column 12, line 44.
- "60 field/sec." At column 15, line 11.
- Object image size "512 lines having 512 pixels per line" at column 17, line 1.
- A/D converter – "512 pixels per line, 480 active lines (525 total) and eight bits per pixel (256 gray shades)" at column 17, line 49.
- Intensity correction for "specific objects" or the "entire scene" at column 18, lines 30-34.

<u>Interlaced Image:</u>

Fant's images are interlaced at "60 cycle field time" at column 9, line 45 (also see "60 field/sec." At column 15, line 11).

<u>Interpolation – Spatial (construed above)</u>:

Fant teaches spatial interpolation. For example, refer to:

- "linearly interpolates each input line to a different size and position in the output image" at column 18, line 51. "size and position parameter for each interpolation are determined from the input image corner coordinates and the output corner coordinates" at column 18, line 54. "interpolation consumes consecutive input pixels and generates consecutive output pixels" at column 18, line 56. "two passes" at column 18, line 58.
- "each pass simply sizes (enlarges or reduces) the input line and position (offset) it in the output video image" and "both of these operations are accomplished by continuous interpolation over the discrete field of pixels" at column 19, line 1; "continuous line sizing and subpixel positioning of output lines and columns which complete eliminate aliasing of diagonal edges" at column 19, line 3.
- Column 19, lines 9+.
- "bilinear interpolations" at column 29, line 32.

Interpolation – Temporal (construed above):

Fant describes an image processing at figure 19, whereby several frames of dust are interpolated to create in-between frames of dust resulting in a smooth flowing dust sequence. Fant states describes the process as follows:

Several dust images are created ("five to ten dust transmission masks may be created" at column 12, line 30).

Images between the dust images are created by interpolation and stored ("A series of linear interpolations between the various masks ... produce a series of frames which are stored in a video disk" at column 12, line 32.

The series of masks are subsequently warped to suit the scene ("warp function ... places the mask in the correct perspective, size and position in the scene" at column 12, line 34).

The color and intensity of the dust sequences is predetermined ("initial condition determines color and intensity" at column 12, line 36).

The final result is a "series of new frames with smooth flowing dust" (figure 19). The fact that initial set of frames represented a coarse time sequence of dust, that fact that in-between frames are interpolated and the fact that a time series of "smooth flowing dust" is created makes this a process of temporal (i.e., time) interpolation.

Iterative Processing (construed above):

See Progressive/Iterative Processing

Kernel Filtering:

See Filtering

Light Sources:

Fant teaches generating and projecting light sources in the scene images. For example, refer to:

- "light sources are laid out from a string of points stored in memory and a warp algorithm warps the surface from a normal view to the vehicle perspective" at column 11, line 30.

- Glint and Glare: "a sector mask is developed based upon the glint and glare bright areas produced by different sun angles" at column 12, line 58. Figure 21. "the sectors in the mask are gray levels" at column 12, line 60. "the sun angle table data sets the look-up tables on the object processor" at column 12, line 63. "look up table sets the output glint and glare values to a predetermined level" at column 12, line 66. "remaining output in the look up table are zero" at column 12, line 67. E.G., "bright spot in sector 2" and "as the turret moves or the sun moves, the sector changes" at column 12, line 68.

Look Up Table:

Fant discloses the use of look-up-tables. For example, refer to:

- For glint and glare: "the sectors in the mask are gray levels" at column 12, line 60. "the sun angle table data sets the look-up tables on the object processor" at column 12, line 63. "look up table sets the output glint and glare values to a predetermined level" at column 12, line 66. "remaining output in the look up table are zero" at column 12, line 67. E.G., "bright spot in sector 2" and "as the turret moves or the sun moves, the sector changes" at column 12, line 68.
- Figure 31, numeral 34.
- "lookup table or lut 34 modifies the intensity values of images for range and contrast effects" at column 17, line 64.

- "maps input intensity values into output intensity values via the data stored in the LUT" at column 18, line 23. Intensity correction for "specific objects" or the "entire scene" at column 18, lines 30-34.

<u>Mapping – Image Mapping</u>:

Fant discloses image mapping. For example, refer to:

- Figures 30 and 31 depict warping by mapping through a transform. Figure 30 depicts the transform, and figure 31 depicts the memory from which and to which pixels are mapped.
- "linear warp algorithm … mapping of the image from the input frame 25 to the screen frame 26" at column 17, line 19.
- Figure 30.
- "the screen coordinates of the four vertices to the enclosed space of which the input image of each OSSE is to be mapped" at column 17, line 27.

<u>Mask – Transmission Mask</u>:

Fant discloses masking an image. For example, refer to:

- "mask controls the transmission" at column 6, line 25.
- Uses stored "intensity masks" at column 8, line 57; "intensity value input controls the intensity/color of the special effects such as black smoke and white clouds" at column 8, line 60.
- "translucent objects or images add further realism … smoke, fog, dust, shadows, and haze" at column 11, line 38.

- The "mask determines the combining percent of object and special effects" at column 11, line 41. "A second variable controls the intensity or color of the special-effect object" at column 11, line 42. "The mask determines the mixing ratio of the special effect with the background fixed variable-control intervals" at column 11, line 44. "generate dust clouds rolling up behind a moving tank" at column 11, line 47. Output Pixel = (1-mask value) x (background) + (mask value) x (special effects value) at column 11, line 59.
- "five to ten dust transmission masks may be created" at column 12, line 30.
- See shadow processing of figure 20.

<u>Memory Loading</u>:

Fant discloses memory loading and memory control operations. For example, refer to:

- Column 17, lines 50-63.
- "memory controller" at column 18, line 35.
- "load" at column 23, line 52.
- "Image Address to Memory Address Mapping" at column 24, lines 3+.

<u>Memory Map (construed above)</u>:

See Memory - RAM

<u>Memory Loading Circuit</u>:

Fant discloses a memory loading circuit for loading an image, or a portion thereof, from the database into a memory for subsequent processing (figure 31, numeral 30 loads image from the "optical disk" into the high speed memory 32.

Memory – RAM/Memory Processing:

Fant discloses processing memory mapped images. For example, refer to:

- Figure 31, numerals 32 and 38.
- "high-speed memory card", "loading depends on the rotation of the image", "minimize pixel compression" at column 17, lines 51-56.
- Memory Map: "high-speed read/write X and Y axis memory" at column 18, line 4 and column 17, line 51.
- "memory controller" at column 18, line 35.
- Memory Map: "spatial transforms on a digital image represented as a matrix of intensity values" at column 18, line 44.
- "Two-Axis Fast Memory" at column 23, lines 49+.
- "Image Address to Memory Address Mapping" at column 24, lines 3+.

Mosaic:

Fant discloses generating mosaic images. For example, refer to: "clumps of small patches may be warped and layed out to form a continuous high texture large surface" at column 13, line 67; "collection of many small patches" at column 14, line 2; "water, rocks, roads, railroad tracks, etc." at column 14, line 10; "patches can have dynamic motion … wind or rotor

blast" at column 14, line 12; "storing a series of dynamic frames on the optical disk and feeding the frames through the surface processors" at column 13, line 15.

Moving Images or Motion:

Fant disclose motion images, or images depicting objects in motion as follows:

- "the tank may be moving" at column 6, line 9.
- "accept video inputs" and "outputs may be real-time video signals" at column 8, line 43.
- "during a flyover, the perspective changes by 90 degrees ... simulation may require a series of additional pictures in the vertical axis" at column 10, line 63.
- "display in various perspective views in a sequence of scenes" at column 11, line 14.
- "generate dust clouds rolling up behind a moving tank" at column 11, line 47. "a warp operation may also be applied to distort the special effect and a series of sequential frames used to generate the motion" at column 11, line 48. Special effects can be "static or dynamic" at column 11, line 51.
- "each pixel may be incremented one or more pixels in the Y axis when frames are played back to produce a continuous circulatory loop" at column 12, line 13. "rate" of playback determines "rate of flow" at column 12, line 25.
- Figures 18 and 19, dust and smoke are in motion.
- "clumps of small patches may be warped and layed out to form a continuous high texture large surface" at column 13, line 67. "collection of many small patches" at column 14, line 2. "water, rocks, roads, railroad tracks, etc." at column 14, line 10. "patches can have dynamic motion ... wind or rotor blast" at column 14, line 12. "storing a series of

dynamic frames on the optical disk and feeding the frames through the surface processors" at column 13, line 15.

Multibit or Multilevel Memory Cells Storing Two (2) or More bits

All memory used by Fant comprises multi-bit memory cells storing at least two bits of data. For example, Fant's databases comprise "either a video (analog) or digital disk ... for storing the images" at column 9, line 11. The disks store "about 6 to 8 bits, or 64 to 256 gray shades" at line 12. In addition, Fant's random access memories (e.g., figure 31, numeral 32 and figure 37) also store the same 6 to 8 bits (see "Two-Axis Fast Memory" at column 23, line 48).

Multiplexing/Demultiplexing (construed above):

The image information from the FOV coordinate transform module in figure 3 is demultiplexed (i.e., uncombined) and transmitted to the plurality of processing channels, where it is again multiplexed (i.e., combined) at the Scene Construction modules.

"Memory controller 50 may be implemented by a single chip microcomputer and LUT 52 may be implemented as a RAM with multiplex and control circuitry to allow access from both the video data and data in memory controller 50" at column 18, line 35.

"For each request from the processor the proper row or column address is incremented. Pixels are multiplexed out of output registers or into input registers. When the lower 2 bits of the incrementing address change from 11 to 00 a memory cycle is initiated to store four input pixels or read the next four pixels" at column 24, line 50.

Navigational Information:

Navigational information is generated and input to the "vehicle simulation computations" module. See:

- "controls for guiding or navigating it in any direction in, around and through the gaming area in the manner of free flight" at column 4, line 61.
- "controls by a pilot trainee would define the dynamic movement of the helicopter" at column 5, line 3.

Occlude/Occulting:

Fant discloses occluding or occulting images. For example, refer to figures 4-12. Objects are overlaid on a background as well as each other, whereby near objects occlude farther objects. For example, this is clearly seen in figures 10 and 11, where the trees are overlaid and therefore occult background objects. Refer to:

- "assembles the scene based upon range … near objects occlude more distant objects" at column 8, line 28.
- "determine whether or not a particular object is in front of, or behind, other objects in the scene" at column 8, line 35.
- Adds "translucent special effects" at column 8, line 53.
- "translucent objects or images add further realism … smoke, fog, dust, shadows, and haze" at column 11, line 38.

- The "mask determines the combining percent of object and special effects" at column 11, line 41. "A second variable controls the intensity or color of the special-effect object" at column 11, line 42. "The mask determines the mixing ratio of the special effect with the background fixed variable-control intervals" at column 11, line 44. "generate dust clouds rolling up behind a moving tank" at column 11, line 47. Output Pixel = (1-mask value) x (background) + (mask value) x (special effects value) at column 11, line 59.
- Figures 18 and 19, dust and smoke occlude surrounding.
- See shadow processing of figure 20.
- "clearing in the branches to the next object or background with decided realism" at column 15, line 28.
- "features nearer the viewpoint always properly occult features or parts of features farther away" at column 15, line 31. Figures 24-27.

<u>Optical Disk</u>:

See Disk Drive.

<u>Overlaying</u>:

Fant teaches overlaying images onto one another. For example, refer to figures 4-12. Graphic objects are overlaid on a background as well as each other, whereby near objects occlude farther objects. For example, this is clearly seen in figures 10 and 11, where the trees are overlaid and therefore occult background objects. See:

- "sky is added in segments over a distant background" at column 5, line 32.

- "assembles the scene based upon range ... near objects occlude more distant objects" at column 8, line 28.
- "smooth" the "high-frequency edges" at column 8, line 29.
- "determine whether or not a particular object is in front of, or behind, other objects in the scene" at column 8, line 35.
- Adds "translucent special effects" at column 8, line 53.
- "translucent objects or images add further realism ... smoke, fog, dust, shadows, and haze" at column 11, line 38.
- The "mask determines the combining percent of object and special effects" at column 11, line 41. "A second variable controls the intensity or color of the special-effect object" at column 11, line 42. "The mask determines the mixing ratio of the special effect with the background fixed variable-control intervals" at column 11, line 44. "generate dust clouds rolling up behind a moving tank" at column 11, line 47. "a warp operation may also be applied to distort the special effect and a series of sequential frames used to generate the motion" at column 11, line 48. Special effects can be "static or dynamic" at column 11, line 51. Output Pixel = (1-mask value) x (background) + (mask value) x (special effects value) at column 11, line 59.
- Figures 18 and 19, dust and smoke are overlaid.
- See shadow processing of figure 20.

<u>Oversample (construed above):</u>

See Warping below. When Fant changes the size of an image, interpolation is used to fill-in the extra pixels, thus oversampling the images (i.e., adding extra pixels). See, "each pass simply sizes (enlarges or reduces) the input line and position (offset) it in the output video image" and "both of these operations are accomplished by continuous interpolation over the discrete field of pixels" at column 18, line 66 – column 19, line 1. Enlarging requires adding pixels, and thus oversampling. Reducing requires removing pixels, and thus undersampling.

Parallel Processing:

Fant teaches parallel processing as seen in figure 31 ("identical channel hardware is suitable for all three functions" at column 17, line 37).

Pattern Recognition (construed above):

Many of Fant's processing modules perform pattern recognition. For example:

- Database Construction Module: This module separates "objects from their backgrounds" at column 6, line 62. Thus, an object must necessarily be recognized in order to separate it.
- Field of View Coordinate Transform Computations Module: This module "determines if all of any portion of the objects, surfaces and special effects are present in the scene" and determines "what can be seen by the observer" at column 7, lines 35-45. Thus, patterns pertaining to objects, surfaces and special effects are recognized as being visible and therefore subsequently processed for display.

- Scene Construction Module: This module recognizes which objects are in front of, and therefore occlude other objects as described at column 30. Also, this module recognizes edges and foreground-to-background transitions that require smoothing.

Perspective Change:

Fant generates 3D perspective changes. Refer to Three Dimensional or Warping below. Also see:

- figure 14 where a 3D object from a certain perspective is reconstructed from divided, normalized surfaces.
- "display in various perspective views in a sequence of scenes" at column 11, line 14.
- "warp function … places the mask in the correct perspective, size and position in the scene" at column 12, line 34.
- See shadow processing of figure 20.
- Figure 23, and column 15, lines 1-15 – "frames … indexed on the disk in 1-degree increments from 0 to 90 degrees in elevation, for each 1-degree incremental change in azimuth" at column 15, line 3.
- "obtain the correct intensity, color, image, size, location, rotation and perspective …" at column 17, line 43.
- "Perspective Warp Technique" at column 25, line 40+.

Pitch, Roll and Yaw:

Fant generates pitch, roll and yaw information to control the flight simulation. See:

- The "X,Y,Z, roll, pitch and yaw signals indicating instantaneous locations of such vehicles" at column 16, line 8.
- rotational data (yaw, pitch and roll) which defines the changing attitudes of the aircraft" at column 16, line 45.

Polygons:

Fant generates graphical polygons and polygon image information. See:

- "breaking the objects down into subsurfaces" at column 11, line 10.
- 3D object creation of "multisurfaces" at column 14, lines 40-56.
- Refer to figure 14 where a 3D object from a certain perspective is reconstructed from divided, normalized surfaces.

Progressive/Iterative Processing (construed above):

Fant processes images in iterations, progressively leading to a final result. See:

- "linearly interpolates each input line to a different size and position in the output image" at column 18, line 51. "size and position parameter for each interpolation are determined from the input image corner coordinates and the output corner coordinates" at column 18, line 54. "interpolation consumes consecutive input pixels and generates consecutive output pixels" at column 18, line 56. "two passes" at column 18, line 58. "each pass simply sizes (enlarges or reduces) the input line and position (offset) it in the output video image" and "both of these operations are accomplished by continuous interpolation over the discrete field of pixels" at column 19, line 1; "continuous line sizing and

subpixel positioning of output lines and columns which completely eliminate aliasing of diagonal edges" at column 19, line 3.

- See "interpolation" at column 19, lines 8+ and "linear warp" at column 21, lines 4+.
- "polygon formed by the dashed lines" at column 29, line 4.

Radial (construed above) Scan:

During scanning of the object images into the channel processor memory at figure 31, radial scan information is generated. That is, "data is loaded ... and rotated 30 degrees" at column 17, line 58. The rotation is about a center point, thus the subsequent scan is a radial scan.

Range:

Fant generates and processes range information. For example, refer to:

- "intensity of each surface may be varied based upon range or other desired parameters" at column 5, line 48.
- "assembles the scene based upon range" at column 8, line 28.
- "receives range information from the object an surface controllers" at column 8, line 33.
- "based upon range" at column 8, line 55.
- "... size and size changes, provide depth cues" at column 10, line 54.
- "a series of pictures in as small as 1-degree increments in both azimuth and elevation" at column 11, line 1.
- "size the cloud based upon range" at column 12, line 22.

- "features nearer the viewpoint always properly occult features or parts of features farther away" at column 15, line 31.
- "scene construction module uses range data to select each pixel in the final scene" at column 15, line 33. Figures 24-27.
- "yield distance or range of any object or surface" at column 16, line 51.
- "distance of each OSSE from the location of the observer" at column 17, line 25.
- "lookup table or lut 34 modifies the intensity values of images for range and contrast effects" at column 17, line 64.

Range Variable (construed above) Motion and/or Intensity:

Both intensity and motion of objects are processed separately from the remainder of the image scene. For example, the motion of a dust cloud and its corresponding intensity/color are processed at figure 18, and then added to the scene. The motion and intensity of the dust could are independent of the other objects and background information in the scene. Thus, Fant teaches generating range variable motion and intensity (refer to "range variable" construction above). Many other examples of this are evident from the Fant reference (e.g., figure 17, figure 19, figure 30, figures 42-43, etc.)

Radar:

See sensors.

Reduced Detail/Detail Reduction/Reduced Resolution:

Many of Fant's image processing operations reduce the detail within an image. For example:

The masking of figure 17 reduces the object (i.e., the tank) detail by obscuring it;

The feathering of figure 18 reduces the smoke detail by feathering it;

The separation of background images (column 6, line 62) reduces background detail;

The re-sizing of object images reduces detail in those images (i.e., see Warping below);

Etc.

Reduced Frequency/Frequency Reduction:

- "smooth" the "high-frequency edges" at column 8, line 29.
- "Gaussian function" at column 8, line 31.
- "scene value adjustment ... intensity corrections" at column 8, line 47;
- "smoothing ... boundaries" at column 8, line 49.
- "edges are restored" at column 9, line 54.
- A kernel filter is used in the smoothing unit. See, "edge smoothing algorithms may be used, a two-to-eight pixel process using Gaussian pixel weighting is preferred" at column 30, line 67.

Relational Database:

See Database

Roll:

See Pitch, Roll, Yaw.

Rotation:

See Warping

Segmentation:

Fant discloses image segmentation. For example, refer to:

- "separating objects from their backgrounds" at column 6, line 61.
- "separates the image from the background" at column 8, line 26;

Sensors – Image Types:

Fant discloses various sensor types, some of which include:

- "IR, visual, millimeter wave, radar, ... loaded in the object file" at column 13, line 11.
- The imagery "simulates the sensor because it comes from the sensor" at column 13, line 13.
- "parameters of the images or sensor may be modified when building the library or in the setting of intensity values during real-time processing" at column 13, line 15.
- "TV camera" in figure 13.

Scale/Scaling:

See Warping and see Zoom.

Shadow Processing:

Fant teaches shadow processing whereby shadows are projected, or added to images. For example, refer to;

- "translucent objects or images add further realism ... smoke, fog, dust, shadows, and haze" at column 11, line 38.
- Figure 20.

Shear:

Fant teaches generating shear ("shear the image to accommodate wind velocity" at column 12, line 22).

Smoothing: See Filtering.

Spatial Processing/Transforms:

Fant discloses many types of spatial processing. Refer to Warping below. Also see, "spatial transforms on a digital image represented as a matrix of intensity values" at column 18, line 44.

Sub-Pixel Processing:

Fant teaches subpixel processing, whereby pixels are generated for in-between pixel positions. Refer to:

- "each pass simply sizes (enlarges or reduces) the input line and position (offset) it in the output video image" and "both of these operations are accomplished by continuous interpolation over the discrete field of pixels" at column 19, line 1; "continuous line sizing and subpixel positioning of output lines and columns which completely eliminate aliasing of diagonal edges" at column 19, line 3.
- "subpixel" at column 19, line 59.

Terrain Altitude Information:

Referring to figures 4-12, graphic objects are overlaid on a background as well as each other, whereby near objects occlude farther objects. For example, this is clearly seen in figures 10 and 11, where the trees are overlaid and therefore occult background objects. Overlaid graphical information includes terrain information, which has altitude. For example, "trees, rocks, bushes", etc. are added at column 5, line 25. "Peaks and valleys" are added at column 5, line 34. All these and other graphical terrain objects can be overlaid and added to the scene, and all have altitude (i.e., they protrude above the ground).

Texture:

Fant generates texture. For example, refer to:

- "textured surfaces are added" at column 5, line 42.
- "clumps of small patches may be warped and layed out to form a continuous high texture large surface" at column 13, line 67. "collection of many small patches" at column 14, line 2. "water, rocks, roads, railroad tracks, etc." at column 14, line 10. "patches can

have dynamic motion ... wind or rotor blast" at column 14, line 12. "storing a series of dynamic frames on the optical disk and feeding the frames through the surface processors" at column 13, line 15.

- Refer to figure 15.

Three-Dimensional (3D) images/3D Perspective:

Fant performs 3D image processing. For example, refer to:

- "three-dimensional objects (3D)" at column 5, line 67.
- "3D object" at column 6, line 5.
- "multi-surface or 3D building" at column 6, line 11.
- "three dimensional multi-image objects may be stored in a series of images which represent 1-degree increments both azimuth and elevation" at column 10, line 15.
- 3D objects are defined by "reference points which represent the center ground contact point, the center height, and a directional vector or pointing angle" at column 10, line 20.
- "as the elevation changes, the object is transformed between reference points which results in an increased or decreased height, depending upon the perspective" at column 10, line 48.
- "during a flyover, the perspective changes by 90 degrees ... simulation may require a series of additional pictures in the vertical axis" at column 10, line 63.
- "a series of pictures in as small as 1-degree increments in both azimuth and elevation" at column 11, line 1.
- "display in various perspective views in a sequence of scenes" at column 11, line 14.

- Shadow processing of figure 20.
- 3D object creation of "multisurfaces" at column 14, lines 40-56.
- Figure 23, and column 15, lines 1-15 – "frames … indexed on the disk in 1-degree increments from 0 to 90 degrees in elevation, for each 1-degree incremental change in azimuth" at column 15, line 3.
- Refer to figure 14 where a 3D object from a certain perspective is reconstructed from divided, normalized surfaces.
- Three dimensional perspective images are displayed: See "display in various perspective views in a sequence of scenes" at column 11, line 14.

<u>Tomographic (construed above)</u>:

Fant generates tomographic images. For example, refer to:

- For 3D, "simulation may require a series of additional pictures in the vertical axis" at column 10, line 63.
- For 3D, "a series of pictures in as small as 1-degree increments in both azimuth and elevation" at column 11, line 1.
- "3D Multi-View" at column 14, line 57.
- 3D object creation of "multisurfaces" at column 14, lines 40-56.

<u>Topographical Altitude Information:</u>

See Terrain Altitude Information above.

Translation:

See Warping.

Translucent:

Fant generates transparent and translucent image information. See:

- "translucent media" at column 6, line 24.
- Adds "translucent special effects" at column 8, line 53.
- "translucent objects or images add further realism ... smoke, fog, dust, shadows, and haze" at column 11, line 38.
- The "mask determines the combining percent of object and special effects" at column 11, line 41. "A second variable controls the intensity or color of the special-effect object" at column 11, line 42. "The mask determines the mixing ratio of the special effect with the background fixed variable-control intervals" at column 11, line 44. "generate dust clouds rolling up behind a moving tank" at column 11, line 47. "a warp operation may also be applied to distort the special effect and a series of sequential frames used to generate the motion" at column 11, line 48. Special effects can be "static or dynamic" at column 11, line 51. Output Pixel = (1-mask value) x (background) + (mask value) x (special effects value) at column 11, line 59.

Two-Dimensional (2D) images:

Fant generates and process 2D images (e.g., "two-dimensional (2D) objects" at column 5, line 56).

Undersampling (construed above):

See Warping below. When Fant changes the size of an image, pixels are removed, thus undersampling the images (i.e., removing extra pixels). See, "each pass simply sizes (enlarges or reduces) the input line and position (offset) it in the output video image" and "both of these operations are accomplished by continuous interpolation over the discrete field of pixels" at column 18, line 66 – column 19, line 1. Enlarging requires adding pixels, and thus oversampling. Reducing requires removing pixels, and thus undersampling.

Vector:

Fant generates and processes vector information. See:

- 3D objects are defined by "reference points which represent the center ground contact point, the center height, and a directional vector or pointing angle" at column 10, line 20.
- "position vectors which define the changing position of the aircraft relative to the origin" at column 16, line 42.

Video Signals:

Fant generates and processes video signals (e.g., "accept video inputs" and "outputs may be real-time video signals" at column 8, line 43).

Warping:

Fant warps images in many different ways. For example, refer to:

- "individual segments are warped based on minimum and maximum data based elevations and upon viewpoint" at column 5, line 40.
- "warped to fit the screen coordinates of the surface polygons, and then added to the scene" at column 5, line 48.
- "change a stored image in normal straight-on perspective to scene conditions ... by changing image, position, size, rotation, and warp" at column 8, line 17.
- "as the elevation changes, the object is transformed between reference points which results in an increased or decreased height, depending upon the perspective" at column 10, line 48.
- "... size and size changes, provide depth cues" at column 10, line 54.
- "a single picture may be stored on a track of the optical disk and processed through a warp operation to obtain the proper rotation, size and position" at column 10, line 57.
- "light sources are laid out from a string of points stored in memory and a warp algorithm warps the surface from a normal view to the vehicle perspective" at column 11, line 30.
- "a warp operation may also be applied to distort the special effect and a series of sequential frames used to generate the motion" at column 11, line 48.
- "warp function ... used to expand the top to simulate diffusion" at column 12, line 20.
- "size the cloud based upon range" at column 12, line 22.
- "position the cloud in the scene" at column 12, line 23.
- The top of smoke cloud "is feathered" at column 12, line 16.
- "warp function ... places the mask in the correct perspective, size and position in the scene" at column 12, line 34.

- Shadow processing of figure 20.
- "textured imagery may be warped to produce textured surfaces" at column 14, line 26. "Linear warping may by used on near square 'objects', but true perspective warp should be used for realistic representation of long narrow 'objects'" at column 14, line 30.
- "linear warp algorithm … mapping of the image from the input frame 25 to the screen frame 26" at column 17, line 19.
- Figure 30.
- Figure 31, and column 17, line 35-column 18, line 13.
- "obtain the correct intensity, color, image, size, location, rotation and perspective …" at column 17, line 43.
- "warp card 36 transforms the image in the Y axis on a line-by-line basis" at column 17, line 68; "magnification factors shift and compress or expand the pixels of each line" at column 18, line 2.
- Column 21, lines 4+.
- "Perspective Warp Technique" at column 25, line 40+.

<u>Weighting/Summing/Averaging/Scaling</u>:

Fant generates weighted, scaled and averaged images. See:

- "weighed average" at column 29, line 20.
- See column 29, lines 1-52.
- "edge smoothing algorithms may be used, a two-to-eight pixel process using Gaussian pixel weighting is preferred" at column 30, line 67.

Windowing:

Fant windows images. For example, referring to figure 15, a "texture" image is photographed, digitized, axis changed, luminance corrected, color corrected, windowed, transferred to tape and then to an optical disk. Also refer to figure 28.

All of Fant's images are windows, given that they are square or rectangular and represent a scene as viewed from a cockpit window (e.g., figure 28, numeral 22).

Wrapped-Around Image Information:

Fant discloses wrapping-around image information in several places in the specification, one of which is exemplified here. Figure 18, and specification column 12, lines 7-26, illustrate and describe the process of generating dynamic (i.e., moving) smoke. First, a "smoke mask" image is created at step A of figure 18. Then top and bottom of the smoke are of the same width and location. Then, a series of frames are generated by incrementing the initial smoke image by one or more pixels in the vertical (Y) axis. As seen in step B of figure 18, at each Y axis increment, the image information is wrapped around from the top to the bottom of the image, or vice-versa ("wrap around in (Y) to produce vertical flow" at figure 18, step B; "each pixel may be incremented one or more pixels in the Y axis when frames are played back to produce a continuous circulatory loop" at column 12, line 13).

Yaw:

See Pitch, Roll, Yaw.

Zoom:

See Warping.

Fant discloses displaying a moving 3D-perspective image simulating an observer roaming through an environment and zooming-in on features of interest in the environment to examine the features of interest in response to the display image information (col. 4, line 49-col. 5, line 31 and col. 14, line 57-col. 15, line 17). Fant explains that the helicopter simulator system provides continuous helicopter pilot eye-view image scenes corresponding to the gaming area, wherein the gaming area includes a variety of features of interest (figure 12). Fant further explains that the system generates the continuous image scenes in response to controls (driving function) for guiding or navigating the helicopter in any direction in the gaming area. For instance, if the helicopter was operated to head towards a feature of interest such as the tank in figure 12, then the tank in each of the eye-view image scenes would zoom-in as the helicopter approaches it. Accordingly, the guidance of the helicopter simulator towards a feature of interest provides a zooming-in on the feature of interest, and allows the feature of interest to be examined in response to the display image information (eye-view scenes).

Claim Rejections - 35 USC § 103

17. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

18. Claims 244, 245, 262, and 381 are rejected under 35 U.S.C. 103(a) as being unpatentable over Jain et al., Displacement Measurement and Its Application in Interframe Image Coding, as applied to claims above, and further in view of Tiemann, 4,375,650.

Jain provides for communicating output image information over a communication link in response to the transformed image information in at least the first full paragraph in the Introduction on page 1799, which can very likely include an RF link, and further with explicit reference to a transmission link in Fig. 6b and "transmit" in Fig. 9. Jain does not explicitly provide for the communication link being RF. Tiemann is in the same environment of video compression (first full paragraph in c. 1 and c. 1, lines 40-44), and further teaches the conventionality of using an RF link in c. 11, lines 50-55, which explicitly uses a "radio frequency relay for transmission to a receiving station", i.e. RF – radio frequency. Jain can clearly use an RF link, as taught by Tiemann, to communicate to the decoder/receiver, since Jain already discloses a television video signal which can be transmitted over a transmission link. It would've been obvious to one having ordinary skill in the art at the time the invention was made to use an RF link to transmit the compressed video of Jain, since an RF communication link provides for at least the advantages of wireless communication, because RF can provide for either or both of a wide coverage area as well as long range distance depending on the transmitter, and also because Tiemann also recites that such a communication link is "appropriate".

Jain provides for blocks of, inter alia, 16 x 16 in the first paragraph in section III on page 1801. Jain is probably not restricted to such an example, since Jain also teaches block sizes in

general, i.e. M x N in the first full paragraph on page 1800. Tiemann provides for using an 8 x 8 block of pixels in at least the first full paragraph in c. 4 and as shown in Fig. 2. Jain can clearly use 8 x 8 blocks instead of 16 x 16 blocks, and it is also clear that Tiemann and Jain are in the same environment of video compression (first full paragraph in c. 1 and c. 1, lines 40-44, of Tiemann). It would've been obvious to one having ordinary skill in the art at the time the invention was made to use 8 x 8 blocks with the video data compression system of Jain, since 8 x 8 blocks as suggested by Jain, would reduce complexity and would be faster, and because Tiemann uses the 8 x 8 blocks in conjunction with transformation, which "greatly simplifies the calculation" as noted in c. 5, lines 57-58.

19. Claim 143 is rejected under 35 U.S.C. 103(a) as being unpatentable over the combination of Sacks et al. (US 4,736,437 A) and Pincoffs et al. (US 3,638,188 A).

Notes:

- Intended use limitations in the body of the claim are not given weight.
- The details of Sacks as described above are incorporated herein by reference, and will not be repeated here.

While Sacks discloses the comparison of a video image with a reference images as described above, Sacks does not teach the input and comparison of an IR or an Radar image with that of a corresponding reference.

Pincoffs discloses a pattern recognition system ("pattern recognition" at column 1, line 8) comprising comparing an input image with a reference image ("observed features are compared with a reference" at column 3, line 29), comprising inputting and comparing not only optical images, but also IR and Radar images ("infrared sensors" and "radar" at column 9, lines 69-70).

It would have been obvious at the time the invention was made to one of ordinary skill in the art to adapt Sacks to not only input and compare images, but also IR and radar images as taught Pincoffs, thereby expanding the capabilities of Sacks by allowing the "image under observation [to be] compiled from a plurality of sources ... of multispectral character" (Pincoffs, column 9, line 64).

20. Claims 116, 131, 149, 166, 226 and 301, as well as their corresponding dependent claims, are rejected under 35 U.S.C. 103(a) as being unpatentable over the combination of Fant (US 4,835,532 A) and Maguer et al. (US 3,967,233 A).

Notes:

- Intended use limitations in the body of the claim are not given weight.
- The details of Fant as described above are incorporated herein by reference, and will not be repeated here.

Fant teaches that a variety of sensors can be used to capture and stored the database images ("based on sensed IR, MMW, radar, etc." at column 6, line 52). Fant does not limit the domain in which the images are captured ("If a group be working in a certain domain--IR, visual,

millimeter wave, or radar, imagery from that sensor is loaded in the object file" at column 13, line 11).

Fant does not teach "sonar" or "ultra-sound" as sensor information.

Maguer discloses capturing images of surfaces and objects using a sonar system ("recognize the shape of the ocean bottom or ... an object on the bottom or floating near the bottom" at column 1, line 13; "sonar ... furnish an image on a screen ... sufficient to permit identification of the object" at column 1, lines 61-65). The sonar emits and receives ultra-sound information (figure 1, numerals 3 and 4; "very short, periodic acoustic pulses" at column 1, line 68; "420KHz" at column 3, line 36).

It would have been obvious at the time the invention was made to one of ordinary skill in the art to utilize sonar/ultra-sound sensors as taught by Maguer, in order to capture images of objects and surfaces for storage and subsequent use by the simulation system of Fant. One would be motivated to add the sonar/ultra-sound sensor and image information of Maguer to the input sensors and database of Fant because of its "precise resolving power" (Maguer, column 1, line 63) and ability to provide images with "clarity, definition and contrast sufficient to permit identification of [an] object" (Maguer, column 1, line 64), thereby providing high quality image for Fant's simulations. Further, this modification would also allow Fant's system to simulate other vehicles, such as ships, deep sea diving apparatus and/or submarines which would have been obvious to one skilled in the art because all types of vehicles need simulation for training purposes.

21. Claim 167, as well as its corresponding dependent claims, are rejected under 35 U.S.C. 103(a) as being unpatentable over the combination of Fant (US 4,835,532 A) and Maguer et al. (US 3,967,233 A) and Cleminson (US 4,675,829 A).

Notes:

- Intended use limitations in the body of the claim are not given weight.
- The details of Fant as described above are incorporated herein by reference, and will not be repeated here.

Fant teaches that a variety of sensors can be used to capture and stored the database images ("based on sensed IR, MMW, radar, etc." at column 6, line 52). Fant does not limit the domain in which the images are captured ("If a group be working in a certain domain--IR, visual, millimeter wave, or radar, imagery from that sensor is loaded in the object file" at column 13, line 11).

Fant does not teach "sonar" or "ultra-sound" as sensor information.

Maguer discloses capturing images of surfaces and objects using a sonar system ("recognize the shape of the ocean bottom or … an object on the bottom or floating near the bottom" at column 1, line 13; "sonar … furnish an image on a screen … sufficient to permit identification of the object" at column 1, lines 61-65). The sonar emits and receives ultra-sound information (figure 1, numerals 3 and 4; "very short, periodic acoustic pulses" at column 1, line 68; "420KHz" at column 3, line 36).

It would have been obvious at the time the invention was made to one of ordinary skill in the art to utilize sonar/ultra-sound sensors as taught by Maguer, in order to capture images of objects and surfaces for storage and subsequent use by the simulation system of Fant. One would be motivated to add the sonar/ultra-sound sensor and image information of Maguer to the input sensors and database of Fant because of its "precise resolving power" (Maguer, column 1, line 63) and ability to provide images with "clarity, definition and contrast sufficient to permit identification of [an] object" (Maguer, column 1, line 64), thereby providing high quality image for Fant's simulations. Further, this modification would also allow Fant's system to simulate other vehicles, such as ships, deep sea diving apparatus and/or submarines which would have been obvious to one skilled in the art because all types of vehicles need simulation for training purposes.

The various modules (e.g., figure 3) of the Fant system each make artificial intelligence type decisions as described above, thus adhering to the construction of the term "artificial intelligence" as applied by the examiner. However, these processing blocks do not adhere to a more rigorous definition of "artificial intelligence" (not relied upon by the examiner) in the art. However, even if Fant does not meet a more rigorous definition, the use of artificial intelligence would have been obvious at the time the invention was made as follows.

Cleminson states, at column 1, lines 10-34:

"Artificial intelligence (AI) technology is a discipline with an ultimate goal of providing a machine that is capable of reasoning, making inferences and following rules in a manner believed to model the human mind. A great deal of theoretical work has been done in this

discipline, and much remains to be done. Artificial intelligence theory is beginning to find applications because of the hope that its principles can be effectively applied to develop better computer software and to provide to relatively untrained users sophisticated computer power to solve practical problems such as to assist in the analysis of massive amounts of relatively unprocessed data to aid in decision-making processes.

As AI technology begins to demonstrate potential and practical uses, tools are needed to speed development of practical computational systems. AI specialists have developed a number of AI-dedicated computer languages to assist in this development. Among the languages are LISP and PROLOG. However, these languages are not particularly easy for either skilled AI researchers or minimally-trained user/programmers to use to develop sophisticated and complex knowledge bases necessary to solve the problems related to artificial intelligence applications. Hence, tools are needed which are better suited to the requirements of both a minimally-trained knowledge base user and a skilled AI researcher."

It would have been obvious at the time the invention was made to one of ordinary skill in the art to utilize the artificial intelligence processing as described by Cleminson above, either in the software and/or hardware of Fant's various processing modules (e.g., figure 3), in order to:

provide "a machine that is capable of reasoning, making inferences and following rules in a manner believed to model the human mind", and

"to develop better computer software and to provide to relatively untrained users sophisticated computer power to solve practical problems such as to assist in the analysis of massive amounts of relatively unprocessed data to aid in decision-making processes",

Thereby improving the speed and accuracy with which Fant's processing modules make their respective decisions.

22. Claims 120, 207, 232, 381 and 571, as well as their corresponding dependent claims, are rejected under 35 U.S.C. 103(a) as being unpatentable over the combination of Fant (US 4,835,532 A) and Tescher (US 4,541,012 A).

Notes:

- Intended use limitations in the body of the claim are not given weight.
- The details of Fant as described above are incorporated herein by reference, and will not be repeated here.

While Fant discloses the storage and processing of digital images ("digital disk ... 12-bit data" at column 9, line 13), Fant does not teach processing the images as 8 X 8 or 64-pixel blocks of image information.

Tescher discloses an image processing system comprising dividing the images into eight by eight pixel blocks, or stated another way, into 64-pixel blocks ("In the preferred embodiment, the method is optimized by employing a total of 64 pixels per block arranged in an 8 by 8 array ..." at column 2, line 56).

It would have been obvious at the time the invention was made to one of ordinary skill in the art to divide the images of Fant into eight by eight blocks of pixels (i.e., 64-pixel blocks) for subsequent processing of the images in order to "optimize" computational efficiency by

performing successive operations on individual 64-pixel blocks instead of on the entire image all at once. That is, Tescher states, "the relevant criteria for selecting appropriate block sizes are the processing time" (column 12, line 17), and "in general, larger blocks require more processing time" (column 12, line 22), and "a smaller block size may be necessary in order to provide decoded video signals of good subjective quality" (column 12, line 28). Thus, one would be motivated to divide an image into 64-pixel blocks as taught by Tescher in order to "optimize" the "processing time" while at the same time achieving "good subjective quality".

23.. Claim 211, as well as its corresponding dependent claims, are rejected under 35 U.S.C. 103(a) as being unpatentable over the combination of Fant (US 4,835,532 A) and Tescher (US 4,541,012 A) and Taylor et al. (US 4,563,703 A).

Notes:

- Intended use limitations in the body of the claim are not given weight.
- The details of Fant as described above are incorporated herein by reference, and will not be repeated here.

While Fant discloses the storage and processing of digital images ("digital disk ... 12-bit data" at column 9, line 13), Fant does not teach processing the images as 8 X 8 or 64-pixel blocks of image information.

Tescher discloses an image processing system comprising dividing the images into eight by eight pixel blocks, or stated another way, into 64-pixel blocks ("In the preferred embodiment,

the method is optimized by employing a total of 64 pixels per block arranged in an 8 by 8 array ..." at column 2, line 56).

It would have been obvious at the time the invention was made to one of ordinary skill in the art to divide the images of Fant into eight by eight blocks of pixels (i.e., 64-pixel blocks) for subsequent processing of the images in order to "optimize" computational efficiency by performing successive operations on individual 64-pixel blocks instead of on the entire image all at once. That is, Tescher states, "the relevant criteria for selecting appropriate block sizes are the processing time" (column 12, line 17), and "in general, larger blocks require more processing time" (column 12, line 22), and "a smaller block size may be necessary in order to provide decoded video signals of good subjective quality" (column 12, line 28). Thus, one would be motivated to divide an image into 64-pixel blocks as taught by Tescher in order to "optimize" the "processing time" while at the same time achieving "good subjective quality".

While Fant discloses warping by translating and scaling an image, Fant does not disclose processor for both weighting and scaling the image.

Taylor discloses a system for provide "special effects" (column 1, line 7) to "reconstitute a picture of different shape or size to that input to the store" (column 1, line 13), which is "capable of producing greater flexibility in picture manipulation whilst maintaining picture quality so that the resultant picture is not noticeably degraded" at column 1, line 20. Taylor's system comprises weighting (figure 3, numeral 20; "K" weights incoming pixels) and scaling (figure 3, numeral 38; the output of summer 38 includes a reduced size image, such as that depicted in figure 2c; e.g., "2:1 reduction in picture size" at column 3, line 26) using integral and

fractional addresses (figure 3, numeral 12). Taylor's system is also capable of range variable processing (figure 5; "variable compression" at column 3, line 43).

It would have been obvious at the time the invention was made to one of ordinary skill in the art to incorporate the special effects processing of Taylor into the object channel processing, scene construction and/or special effects processing blocks of Fant (e.g., figure 3), in order to provide the translation and scaling processing required by Fant, thereby providing Fant with the additional capability of producing special effects not currently supported (e.g., Taylor figure 5), and because of its capability of "producing greater flexibility in picture manipulation whilst maintaining picture quality so that the resultant picture is not noticeably degraded" (Taylor, column 1, line 20).

24. Claims 556 and 572, as well as their corresponding dependent claims, are rejected under 35 U.S.C. 103(a) as being unpatentable over the combination of Fant (US 4,835,532 A) and Tescher (US 4,541,012 A) and Mosier (US 4,583,094 A).

Notes:

- Intended use limitations in the body of the claim are not given weight.
- The details of Fant as described above are incorporated herein by reference, and will not be repeated here.

While Fant discloses the storage and processing of digital images ("digital disk ... 12-bit data" at column 9, line 13), Fant does not teach processing the images as 8 X 8 or 64-pixel blocks of image information.

Tescher discloses an image processing system comprising dividing the images into eight by eight pixel blocks, or stated another way, into 64-pixel blocks ("In the preferred embodiment, the method is optimized by employing a total of 64 pixels per block arranged in an 8 by 8 array ..." at column 2, line 56).

It would have been obvious at the time the invention was made to one of ordinary skill in the art to divide the images of Fant into eight by eight blocks of pixels (i.e., 64-pixel blocks) for subsequent processing of the images in order to "optimize" computational efficiency by performing successive operations on individual 64-pixel blocks instead of on the entire image all at once. That is, Tescher states, "the relevant criteria for selecting appropriate block sizes are the processing time" (column 12, line 17), and "in general, larger blocks require more processing time" (column 12, line 22), and "a smaller block size may be necessary in order to provide decoded video signals of good subjective quality" (column 12, line 28). Thus, one would be motivated to divide an image into 64-pixel blocks as taught by Tescher in order to "optimize" the "processing time" while at the same time achieving "good subjective quality".

Fant teaches a vehicle simulator as already described. In particular, Fant teaches a "flight" simulator comprising generating navigational information ("The helicopter simulator would be equipped with controls for guiding or navigating it in any direction in, around and through the gaming area in the manner of free flight" at column 4, line 60; "determine the

locations … for the primary vehicle" at column 7, line 16). Fant does not elaborate on the "controls for guiding or navigating", and in particular Fant does not teach generating GPS navigation information as part of those controls. However, it is well know in the art that a flight simulator should simulate, as accurately as possible, actual flight including the controls and indicators normally found in a cockpit.

Mosier discloses providing an aircraft with a comprehensive navigation display (figure 1) comprising GPS navigation information received from GPS satellites ("Similarly, global positioning system information can be displayed …" at column 6, line 12; "GPS" is a satellite based system whereby a plurality of satellites transmit time and position information from which coordinates of a terrestrial vehicle can be determined).

It would have been obvious at the time the invention was made to one of ordinary skill in the art to provide, as part of the controls and indicators of the Fant simulator, the navigation instruments including the GPS information of Mosier, in order to provide the pilot with "a valuable flight assistance tool during both visual flight rules and instrument flight rules flights" (Mosier, column 6, line 19) thereby proving a more realistic flight simulation experience, and to assist the pilot in providing him/her with exact location coordinates, and to provide the specific orientation and navigation inputs to Fant's "vehicle simulation computations" module for subsequently controlling and flight path through the gaming area, thereby simulating as accurately as possible actual flight including the controls and indicators normally found in a cockpit.

25. Claim 567, as well as its corresponding dependent claims, are rejected under 35 U.S.C. 103(a) as being unpatentable over the combination of Fant (US 4,835,532 A) and Tescher (US 4,541,012 A) and Sidoti (US 3,885,325 A).

Notes:

- Intended use limitations in the body of the claim are not given weight.
- The details of Fant as described above are incorporated herein by reference, and will not be repeated here.

While Fant discloses the storage and processing of digital images ("digital disk ... 12-bit data" at column 9, line 13), Fant does not teach processing the images as 8 X 8 or 64-pixel blocks of image information.

Tescher discloses an image processing system comprising dividing the images into eight by eight pixel blocks, or stated another way, into 64-pixel blocks ("In the preferred embodiment, the method is optimized by employing a total of 64 pixels per block arranged in an 8 by 8 array ..." at column 2, line 56).

It would have been obvious at the time the invention was made to one of ordinary skill in the art to divide the images of Fant into eight by eight blocks of pixels (i.e., 64-pixel blocks) for subsequent processing of the images in order to "optimize" computational efficiency by performing successive operations on individual 64-pixel blocks instead of on the entire image all at once. That is, Tescher states, "the relevant criteria for selecting appropriate block sizes are the processing time" (column 12, line 17), and "in general, larger blocks require more processing

time" (column 12, line 22), and "a smaller block size may be necessary in order to provide decoded video signals of good subjective quality" (column 12, line 28). Thus, one would be motivated to divide an image into 64-pixel blocks as taught by Tescher in order to "optimize" the "processing time" while at the same time achieving "good subjective quality".

Fant teaches a vehicle simulator as already described. In particular, Fant teaches a "flight" simulator comprising generating navigational information ("The helicopter simulator would be equipped with controls for guiding or navigating it in any direction in, around and through the gaming area in the manner of free flight" at column 4, line 60; "determine the locations ... for the primary vehicle" at column 7, line 16). Fant does not elaborate on the "controls for guiding or navigating", and in particular Fant does not teach generating inertial navigation information as part of those controls. However, it is well know in the art that a flight simulator should simulate, as accurately as possible, actual flight including the controls and indicators normally found in a cockpit.

Sidoti discloses a flight simulator comprising generating inertial navigation information (figure 1, numeral 15; "a directional gyro compass 15" at column 1, line 37).

It would have been obvious at the time the invention was made to one of ordinary skill in the art to provide, as part of the controls and indicators of the Fant simulator, the navigation instruments including the inertial navigation information of Sidoti, in order to "simulate instruments normally found in an aircraft for orientation and navigation" (Sidoti, column 1, line 35) thereby proving a more realistic flight simulation experience, and to provide the specific

orientation and navigation inputs to Fant's "vehicle simulation computations" module for subsequently controlling and flight path through the gaming area.

26. Claims 139, 196, 252, 422, 427, 558, 568, 570, 574 and 582, as well as their corresponding dependent claims, are rejected under 35 U.S.C. 103(a) as being unpatentable over the combination of Fant (US 4,835,532 A) and Mosier (US 4,583,094 A).

Notes:

- Intended use limitations in the body of the claim are not given weight.
- The details of Fant as described above are incorporated herein by reference, and will not be repeated here.

Fant teaches a vehicle simulator as already described. In particular, Fant teaches a "flight" simulator comprising generating navigational information ("The helicopter simulator would be equipped with controls for guiding or navigating it in any direction in, around and through the gaming area in the manner of free flight" at column 4, line 60; "determine the locations ... for the primary vehicle" at column 7, line 16). Fant does not elaborate on the "controls for guiding or navigating", and in particular Fant does not teach generating GPS navigation information as part of those controls. However, it is well know in the art that a flight simulator should simulate, as accurately as possible, actual flight including the controls and indicators normally found in a cockpit.

Mosier discloses providing an aircraft with a comprehensive navigation display (figure 1) comprising GPS navigation information received from GPS satellites ("Similarly, global positioning system information can be displayed ..." at column 6, line 12; "GPS" is a satellite based system whereby a plurality of satellites transmit time and position information from which coordinates of a terrestrial vehicle can be determined).

It would have been obvious at the time the invention was made to one of ordinary skill in the art to provide, as part of the controls and indicators of the Fant simulator, the navigation instruments including the GPS information of Mosier, in order to provide the pilot with "a valuable flight assistance tool during both visual flight rules and instrument flight rules flights" (Mosier, column 6, line 19) thereby proving a more realistic flight simulation experience, and to assist the pilot in providing him/her with exact location coordinates, and to provide the specific orientation and navigation inputs to Fant's "vehicle simulation computations" module for subsequently controlling and flight path through the gaming area, thereby simulating as accurately as possible actual flight including the controls and indicators normally found in a cockpit.

27. Claims 274, 552 and 577 as well as their corresponding dependent claims, are rejected under 35 U.S.C. 103(a) as being unpatentable over the combination of Fant (US 4,835,532 A) and Mosier (US 4,583,094 A) and Cleminson (US 4,675,829 A).

Notes:

- Intended use limitations in the body of the claim are not given weight.

- The details of Fant as described above are incorporated herein by reference, and will not be repeated here.

Fant teaches a vehicle simulator as already described. In particular, Fant teaches a "flight" simulator comprising generating navigational information ("The helicopter simulator would be equipped with controls for guiding or navigating it in any direction in, around and through the gaming area in the manner of free flight" at column 4, line 60; "determine the locations ... for the primary vehicle" at column 7, line 16). Fant does not elaborate on the "controls for guiding or navigating", and in particular Fant does not teach generating GPS navigation information as part of those controls. However, it is well know in the art that a flight simulator should simulate, as accurately as possible, actual flight including the controls and indicators normally found in a cockpit.

Mosier discloses providing an aircraft with a comprehensive navigation display (figure 1) comprising GPS navigation information received from GPS satellites ("Similarly, global positioning system information can be displayed ..." at column 6, line 12; "GPS" is a satellite based system whereby a plurality of satellites transmit time and position information from which coordinates of a terrestrial vehicle can be determined).

It would have been obvious at the time the invention was made to one of ordinary skill in the art to provide, as part of the controls and indicators of the Fant simulator, the navigation instruments including the GPS information of Mosier, in order to provide the pilot with "a valuable flight assistance tool during both visual flight rules and instrument flight rules flights" (Mosier, column 6, line 19) thereby proving a more realistic flight simulation experience, and to

assist the pilot in providing him/her with exact location coordinates, and to provide the specific orientation and navigation inputs to Fant's "vehicle simulation computations" module for subsequently controlling and flight path through the gaming area, thereby simulating as accurately as possible actual flight including the controls and indicators normally found in a cockpit.

The various modules (e.g., figure 3) of the Fant system each make artificial intelligence type decisions as described above, thus adhering to the construction of the term "artificial intelligence" as applied by the examiner. However, these processing blocks do not adhere to a more rigorous definition of "artificial intelligence" (not relied upon by the examiner) in the art. However, even if Fant does not meet a more rigorous definition, the use of artificial intelligence would have been obvious at the time the invention was made as follows.

Cleminson states, at column 1, lines 10-34:

"Artificial intelligence (AI) technology is a discipline with an ultimate goal of providing a machine that is capable of reasoning, making inferences and following rules in a manner believed to model the human mind. A great deal of theoretical work has been done in this discipline, and much remains to be done. Artificial intelligence theory is beginning to find applications because of the hope that its principles can be effectively applied to develop better computer software and to provide to relatively untrained users sophisticated computer power to solve practical problems such as to assist in the analysis of massive amounts of relatively unprocessed data to aid in decision-making processes.

As AI technology begins to demonstrate potential and practical uses, tools are needed to speed development of practical computational systems. AI specialists have developed a number of AI-dedicated computer languages to assist in this development. Among the languages are LISP and PROLOG. However, these languages are not particularly easy for either skilled AI researchers or minimally-trained user/programmers to use to develop sophisticated and complex knowledge bases necessary to solve the problems related to artificial intelligence applications. Hence, tools are needed which are better suited to the requirements of both a minimally-trained knowledge base user and a skilled AI researcher."

It would have been obvious at the time the invention was made to one of ordinary skill in the art to utilize the artificial intelligence processing as described by Cleminson above, either in the software and/or hardware of Fant's various processing modules (e.g., figure 3), in order to:

provide "a machine that is capable of reasoning, making inferences and following rules in a manner believed to model the human mind", and

"to develop better computer software and to provide to relatively untrained users sophisticated computer power to solve practical problems such as to assist in the analysis of massive amounts of relatively unprocessed data to aid in decision-making processes",

Thereby improving the speed and accuracy with which Fant's processing modules make their respective decisions.

28. Claims 536, 554 and 563, as well as their corresponding dependent claims, are rejected under 35 U.S.C. 103(a) as being unpatentable over the combination of Fant (US 4,835,532 A) and Mosier (US 4,583,094 A) and Tabata et al. (US 4,574,364 A).

Notes:

- Intended use limitations in the body of the claim are not given weight.
- The details of Fant as described above are incorporated herein by reference, and will not be repeated here.

Fant teaches a vehicle simulator as already described. In particular, Fant teaches a "flight" simulator comprising generating navigational information ("The helicopter simulator would be equipped with controls for guiding or navigating it in any direction in, around and through the gaming area in the manner of free flight" at column 4, line 60; "determine the locations ... for the primary vehicle" at column 7, line 16). Fant does not elaborate on the "controls for guiding or navigating", and in particular Fant does not teach generating GPS navigation information as part of those controls. However, it is well know in the art that a flight simulator should simulate, as accurately as possible, actual flight including the controls and indicators normally found in a cockpit.

Mosier discloses providing an aircraft with a comprehensive navigation display (figure 1) comprising GPS navigation information received from GPS satellites ("Similarly, global positioning system information can be displayed ..." at column 6, line 12; "GPS" is a satellite based system whereby a plurality of satellites transmit time and position information from which coordinates of a terrestrial vehicle can be determined).

It would have been obvious at the time the invention was made to one of ordinary skill in the art to provide, as part of the controls and indicators of the Fant simulator, the navigation

instruments including the GPS information of Mosier, in order to provide the pilot with "a valuable flight assistance tool during both visual flight rules and instrument flight rules flights" (Mosier, column 6, line 19) thereby proving a more realistic flight simulation experience, and to assist the pilot in providing him/her with exact location coordinates, and to provide the specific orientation and navigation inputs to Fant's "vehicle simulation computations" module for subsequently controlling and flight path through the gaming area, thereby simulating as accurately as possible actual flight including the controls and indicators normally found in a cockpit.

While Fant teaches the storage of digital image information on the object library disk memory as described above, Fant does not teach compression of the images for storage, and decompression for retrieval.

Tabata discloses a system for the storage of images in a database (figure 3, numeral 5), comprising compressing the images for storage and decompression for display (figure 3, numerals 6 and 10; "for compressing and decompressing the image data" at column 2, line 60).

It would have been obvious at the time the invention was made to one of ordinary skill in the art to perform the compression and decompression of images as taught by Tabata, on the images stored and retrieved from the object data base of Fant, in order to efficiently store the images and thus provide room for the storage of even more images that might not otherwise fit on the optical disk in uncompressed form.

Additionally, it would have been obvious to compress and decompress the images for transmission between the processing blocks of Fant, thus reducing the data for transmission and increasing transmission speed.

29. Claim 147, as well as its corresponding dependent claims, are rejected under 35 U.S.C. 103(a) as being unpatentable over the combination of Fant (US 4,835,532 A) and Tabata et al. (US 4,574,364 A).

Notes:

- Intended use limitations in the body of the claim are not given weight.
- The details of Fant as described above are incorporated herein by reference, and will not be repeated here.

While Fant teaches the storage of digital image information on the object library disk memory as described above, Fant does not teach compression of the images for storage, and decompression for retrieval.

Tabata discloses a system for the storage of images in a database (figure 3, numeral 5), comprising compressing the images for storage and decompression for display (figure 3, numerals 6 and 10; "for compressing and decompressing the image data" at column 2, line 60).

It would have been obvious at the time the invention was made to one of ordinary skill in the art to perform the compression and decompression of images as taught by Tabata, on the images stored and retrieved from the object data base of Fant, in order to efficiently store the

images and thus provide room for the storage of even more images that might not otherwise fit on the optical disk in uncompressed form.

Additionally, it would have been obvious to compress and decompress the images for transmission between the processing blocks of Fant, thus reducing the data for transmission and increasing transmission speed.

30. Claims 195 and 219, as well as their corresponding dependent claims, are rejected under 35 U.S.C. 103(a) as being unpatentable over the combination of Fant (US 4,835,532 A) and Tabata et al. (US 4,574,364 A) and Taylor et al. (US 4,563,703 A).

Notes:

- Intended use limitations in the body of the claim are not given weight.
- The details of Fant as described above are incorporated herein by reference, and will not be repeated here.

While Fant teaches the storage of digital image information on the object library disk memory as described above, Fant does not teach compression of the images for storage, and decompression for retrieval.

Tabata discloses a system for the storage of images in a database (figure 3, numeral 5), comprising compressing the images for storage and decompression for display (figure 3, numerals 6 and 10; "for compressing and decompressing the image data" at column 2, line 60).

It would have been obvious at the time the invention was made to one of ordinary skill in the art to perform the compression and decompression of images as taught by Tabata, on the images stored and retrieved from the object data base of Fant, in order to efficiently store the images and thus provide room for the storage of even more images that might not otherwise fit on the optical disk in uncompressed form.

Additionally, it would have been obvious to compress and decompress the images for transmission between the processing blocks of Fant, thus reducing the data for transmission and increasing transmission speed.

While Fant discloses warping by translating and scaling an image, Fant does not disclose processor for both weighting and scaling the image.

Taylor discloses a system for provide "special effects" (column 1, line 7) to "reconstitute a picture of different shape or size to that input to the store" (column 1, line 13), which is "capable of producing greater flexibility in picture manipulation whilst maintaining picture quality so that the resultant picture is not noticeably degraded" at column 1, line 20. Taylor's system comprises weighting (figure 3, numeral 20; "K" weights incoming pixels) and scaling (figure 3, numeral 38; the output of summer 38 includes a reduced size image, such as that depicted in figure 2c; e.g., "2:1 reduction in picture size" at column 3, line 26) using integral and fractional addresses (figure 3, numeral 12). Taylor's system is also capable of range variable processing (figure 5; "variable compression" at column 3, line 43).

It would have been obvious at the time the invention was made to one of ordinary skill in the art to incorporate the special effects processing of Taylor into the object channel processing,

scene construction and/or special effects processing blocks of Fant (e.g., figure 3), in order to provide the translation and scaling processing required by Fant, thereby providing Fant with the additional capability of producing special effects not currently supported (e.g., Taylor figure 5), and because of its capability of "producing greater flexibility in picture manipulation whilst maintaining picture quality so that the resultant picture is not noticeably degraded" (Taylor, column 1, line 20).

31. Claim 583, as well as its corresponding dependent claims, are rejected under 35 U.S.C. 103(a) as being unpatentable over the combination of Fant (US 4,835,532 A) and Tabata et al. (US 4,574,364 A) and Sidoti (US 3,885,325 A).

Notes:

- Intended use limitations in the body of the claim are not given weight.
- The details of Fant as described above are incorporated herein by reference, and will not be repeated here.

While Fant teaches the storage of digital image information on the object library disk memory as described above, Fant does not teach compression of the images for storage, and decompression for retrieval.

Tabata discloses a system for the storage of images in a database (figure 3, numeral 5), comprising compressing the images for storage and decompression for display (figure 3, numerals 6 and 10; "for compressing and decompressing the image data" at column 2, line 60).

It would have been obvious at the time the invention was made to one of ordinary skill in the art to perform the compression and decompression of images as taught by Tabata, on the images stored and retrieved from the object data base of Fant, in order to efficiently store the images and thus provide room for the storage of even more images that might not otherwise fit on the optical disk in uncompressed form.

Additionally, it would have been obvious to compress and decompress the images for transmission between the processing blocks of Fant, thus reducing the data for transmission and increasing transmission speed.

Fant teaches a vehicle simulator as already described. In particular, Fant teaches a "flight" simulator comprising generating navigational information ("The helicopter simulator would be equipped with controls for guiding or navigating it in any direction in, around and through the gaming area in the manner of free flight" at column 4, line 60; "determine the locations ... for the primary vehicle" at column 7, line 16). Fant does not elaborate on the "controls for guiding or navigating", and in particular Fant does not teach generating inertial navigation information as part of those controls. However, it is well know in the art that a flight simulator should simulate, as accurately as possible, actual flight including the controls and indicators normally found in a cockpit.

Sidoti discloses a flight simulator comprising generating inertial navigation information (figure 1, numeral 15; "a directional gyro compass 15" at column 1, line 37).

It would have been obvious at the time the invention was made to one of ordinary skill in the art to provide, as part of the controls and indicators of the Fant simulator, the navigation

instruments including the inertial navigation information of Sidoti, in order to "simulate instruments normally found in an aircraft for orientation and navigation" (Sidoti, column 1, line 35) thereby proving a more realistic flight simulation experience, and to provide the specific orientation and navigation inputs to Fant's "vehicle simulation computations" module for subsequently controlling and flight path through the gaming area.

32. Claims 159, 161, 163, 165 and 193, as well as their corresponding dependent claims, are rejected under 35 U.S.C. 103(a) as being unpatentable over the combination of Fant (US 4,835,532 A) and Cleminson (US 4,675,829 A).

Notes:

- Intended use limitations in the body of the claim are not given weight.
- The details of Fant as described above are incorporated herein by reference, and will not be repeated here.

The various modules (e.g., figure 3) of the Fant system each make artificial intelligence type decisions as described above, thus adhering to the construction of the term "artificial intelligence" as applied by the examiner. However, these processing blocks do not adhere to a more rigorous definition of "artificial intelligence" (not relied upon by the examiner) in the art. However, even if Fant does not meet a more rigorous definition, the use of artificial intelligence would have been obvious at the time the invention was made as follows.

Cleminson states, at column 1, lines 10-34:

"Artificial intelligence (AI) technology is a discipline with an ultimate goal of providing a machine that is capable of reasoning, making inferences and following rules in a manner believed to model the human mind. A great deal of theoretical work has been done in this discipline, and much remains to be done. Artificial intelligence theory is beginning to find applications because of the hope that its principles can be effectively applied to develop better computer software and to provide to relatively untrained users sophisticated computer power to solve practical problems such as to assist in the analysis of massive amounts of relatively unprocessed data to aid in decision-making processes.

As AI technology begins to demonstrate potential and practical uses, tools are needed to speed development of practical computational systems. AI specialists have developed a number of AI-dedicated computer languages to assist in this development. Among the languages are LISP and PROLOG. However, these languages are not particularly easy for either skilled AI researchers or minimally-trained user/programmers to use to develop sophisticated and complex knowledge bases necessary to solve the problems related to artificial intelligence applications. Hence, tools are needed which are better suited to the requirements of both a minimally-trained knowledge base user and a skilled AI researcher."

It would have been obvious at the time the invention was made to one of ordinary skill in the art to utilize the artificial intelligence processing as described by Cleminson above, either in the software and/or hardware of Fant's various processing modules (e.g., figure 3), in order to:

provide "a machine that is capable of reasoning, making inferences and following rules in a manner believed to model the human mind", and

"to develop better computer software and to provide to relatively untrained users sophisticated computer power to solve practical problems such as to assist in the analysis of massive amounts of relatively unprocessed data to aid in decision-making processes",

Thereby improving the speed and accuracy with which Fant's processing modules make their respective decisions.

33. Claim 569, as well as its corresponding dependent claims, are rejected under 35 U.S.C. 103(a) as being unpatentable over the combination of Fant (US 4,835,532 A) and Cleminson (US 4,675,829 A) and Sidoti (US 3,885,325 A).

Notes:

- Intended use limitations in the body of the claim are not given weight.
- The details of Fant as described above are incorporated herein by reference, and will not be repeated here.

The various modules (e.g., figure 3) of the Fant system each make artificial intelligence type decisions as described above, thus adhering to the construction of the term "artificial intelligence" as applied by the examiner. However, these processing blocks do not adhere to a more rigorous definition of "artificial intelligence" (not relied upon by the examiner) in the art. However, even if Fant does not meet a more rigorous definition, the use of artificial intelligence would have been obvious at the time the invention was made as follows.

Cleminson states, at column 1, lines 10-34:

"Artificial intelligence (AI) technology is a discipline with an ultimate goal of providing a machine that is capable of reasoning, making inferences and following rules in a manner believed to model the human mind. A great deal of theoretical work has been done in this discipline, and much remains to be done. Artificial intelligence theory is beginning to find applications because of the hope that its principles can be effectively applied to develop better computer software and to provide to relatively untrained users sophisticated computer power to solve practical problems such as to assist in the analysis of massive amounts of relatively unprocessed data to aid in decision-making processes.

As AI technology begins to demonstrate potential and practical uses, tools are needed to speed development of practical computational systems. AI specialists have developed a number of AI-dedicated computer languages to assist in this development. Among the languages are LISP and PROLOG. However, these languages are not particularly easy for either skilled AI researchers or minimally-trained user/programmers to use to develop sophisticated and complex knowledge bases necessary to solve the problems related to artificial intelligence applications. Hence, tools are needed which are better suited to the requirements of both a minimally-trained knowledge base user and a skilled AI researcher."

It would have been obvious at the time the invention was made to one of ordinary skill in the art to utilize the artificial intelligence processing as described by Cleminson above, either in the software and/or hardware of Fant's various processing modules (e.g., figure 3), in order to:

provide "a machine that is capable of reasoning, making inferences and following rules in a manner believed to model the human mind", and

"to develop better computer software and to provide to relatively untrained users sophisticated computer power to solve practical problems such as to assist in the analysis of massive amounts of relatively unprocessed data to aid in decision-making processes",

Thereby improving the speed and accuracy with which Fant's processing modules make their respective decisions.

Fant teaches a vehicle simulator as already described. In particular, Fant teaches a "flight" simulator comprising generating navigational information ("The helicopter simulator would be equipped with controls for guiding or navigating it in any direction in, around and through the gaming area in the manner of free flight" at column 4, line 60; "determine the locations ... for the primary vehicle" at column 7, line 16). Fant does not elaborate on the "controls for guiding or navigating", and in particular Fant does not teach generating inertial navigation information as part of those controls. However, it is well know in the art that a flight simulator should simulate, as accurately as possible, actual flight including the controls and indicators normally found in a cockpit.

Sidoti discloses a flight simulator comprising generating inertial navigation information (figure 1, numeral 15; "a directional gyro compass 15" at column 1, line 37).

It would have been obvious at the time the invention was made to one of ordinary skill in the art to provide, as part of the controls and indicators of the Fant simulator, the navigation instruments including the inertial navigation information of Sidoti, in order to "simulate instruments normally found in an aircraft for orientation and navigation" (Sidoti, column 1, line 35) thereby proving a more realistic flight simulation experience, and to provide the specific

orientation and navigation inputs to Fant's "vehicle simulation computations" module for subsequently controlling and flight path through the gaming area.

34. Claims 190, 258, 276, 515, 549, 550, 562, 565 and 581, as well as their corresponding dependent claims, are rejected under 35 U.S.C. 103(a) as being unpatentable over the combination of Fant (US 4,835,532 A) and Sidoti (US 3,885,325 A).

Notes:

- Intended use limitations in the body of the claim are not given weight.
- The details of Fant as described above are incorporated herein by reference, and will not be repeated here.

Fant teaches a vehicle simulator as already described. In particular, Fant teaches a "flight" simulator comprising generating navigational information ("The helicopter simulator would be equipped with controls for guiding or navigating it in any direction in, around and through the gaming area in the manner of free flight" at column 4, line 60; "determine the locations ... for the primary vehicle" at column 7, line 16). Fant does not elaborate on the "controls for guiding or navigating", and in particular Fant does not teach generating inertial navigation information as part of those controls. However, it is well know in the art that a flight simulator should simulate, as accurately as possible, actual flight including the controls and indicators normally found in a cockpit.

Sidoti discloses a flight simulator comprising generating inertial navigation information (figure 1, numeral 15; "a directional gyro compass 15" at column 1, line 37).

It would have been obvious at the time the invention was made to one of ordinary skill in the art to provide, as part of the controls and indicators of the Fant simulator, the navigation instruments including the inertial navigation information of Sidoti, in order to "simulate instruments normally found in an aircraft for orientation and navigation" (Sidoti, column 1, line 35) thereby proving a more realistic flight simulation experience, and to provide the specific orientation and navigation inputs to Fant's "vehicle simulation computations" module for subsequently controlling and flight path through the gaming area.

35. Claims 551, 560 and 576, as well as their corresponding dependent claims, are rejected under 35 U.S.C. 103(a) as being unpatentable over the combination of Fant (US 4,835,532 A) and Sidoti (US 3,885,325 A) and Lam et al. (US 4,576,577 A).

Notes:

- Intended use limitations in the body of the claim are not given weight.
- The details of Fant as described above are incorporated herein by reference, and will not be repeated here.

Fant teaches a vehicle simulator as already described. In particular, Fant teaches a "flight" simulator comprising generating navigational information ("The helicopter simulator would be equipped with controls for guiding or navigating it in any direction in, around and

through the gaming area in the manner of free flight" at column 4, line 60; "determine the locations ... for the primary vehicle" at column 7, line 16). Fant does not elaborate on the "controls for guiding or navigating", and in particular Fant does not teach generating inertial navigation information as part of those controls. However, it is well know in the art that a flight simulator should simulate, as accurately as possible, actual flight including the controls and indicators normally found in a cockpit.

Sidoti discloses a flight simulator comprising generating inertial navigation information (figure 1, numeral 15; "a directional gyro compass 15" at column 1, line 37).

It would have been obvious at the time the invention was made to one of ordinary skill in the art to provide, as part of the controls and indicators of the Fant simulator, the navigation instruments including the inertial navigation information of Sidoti, in order to "simulate instruments normally found in an aircraft for orientation and navigation" (Sidoti, column 1, line 35) thereby proving a more realistic flight simulation experience, and to provide the specific orientation and navigation inputs to Fant's "vehicle simulation computations" module for subsequently controlling and flight path through the gaming area.

While Fant teaches a flight simulator, where the operator has "controls for guiding or navigating it in any direction in, around and through the gaming area in the manner of free flight" at column 4, line 62), Fant does not teach controlling a robot.

Lam discloses a flight simulator ("flight simulator" in the abstract) comprising controlling a robot in response to operator input (e.g., navigation) commands (figure 1 depicts the robot; "In motion simulator systems, and especially in flight simulator motion systems, the

sensation of motion is given by simulating forces acting on the users of the simulator to give the user the feeling of motion. Thus, the systems must take into account the type of motion which should be experienced by the user. That is, there will be different forces acting on the user when the aircraft is supposed to be banking than when the aircraft is supposed to be yawing" at column 1, line 25).

It would have been obvious at the time the invention was made to one of ordinary skill in the art to utilize the operator input commands (e.g., navigational information) of Fant to control a robotic flight simulation platform as taught by Lam, in order to provide "the sensation of motion ... by simulating forces acting on the users of the simulator to give the user the feeling of motion" (Lam, column 1, line 26) thereby creating a more realistic flight simulation.

36. Claim 398, as well as its corresponding dependent claims, are rejected under 35 U.S.C. 103(a) as being unpatentable over the combination of Fant (US 4,835,532 A) and Lam et al. (US 4,576,577 A).

Notes:

- Intended use limitations in the body of the claim are not given weight.
- The details of Fant as described above are incorporated herein by reference, and will not be repeated here.

While Fant teaches a flight simulator, where the operator has "controls for guiding or navigating it in any direction in, around and through the gaming area in the manner of free flight" at column 4, line 62), Fant does not teach controlling a robot.

Lam discloses a flight simulator ("flight simulator" in the abstract) comprising controlling a robot in response to operator input (e.g., navigation) commands (figure 1 depicts the robot; "In motion simulator systems, and especially in flight simulator motion systems, the sensation of motion is given by simulating forces acting on the users of the simulator to give the user the feeling of motion. Thus, the systems must take into account the type of motion which should be experienced by the user. That is, there will be different forces acting on the user when the aircraft is supposed to be banking than when the aircraft is supposed to be yawing" at column 1, line 25).

It would have been obvious at the time the invention was made to one of ordinary skill in the art to utilize the operator input commands (e.g., navigational information) of Fant to control a robotic flight simulation platform as taught by Lam, in order to provide "the sensation of motion ... by simulating forces acting on the users of the simulator to give the user the feeling of motion" (Lam, column 1, line 26) thereby creating a more realistic flight simulation.

37. Claim 133, as well as its corresponding dependent claims, are rejected under 35 U.S.C. 103(a) as being unpatentable over the combination of by Meagher (US 4,694,404 A) and Tucker (US 4,546,433 A).

Notes:

- Intended use limitations in the body of the claim are not given weight.
- The details of Meagher as described above are incorporated herein by reference, and will not be repeated here.

Meagher does not teach generating and storing kernel weight information, and generating kernel filtered image information.

Tucker discloses an image processing system "from which information relating to prominent edges, abrupt discontinuities, and other visual outstanding features are to be extracted so that the remaining extraneous noise and less significant visual features … can be discarded" at column 2, line 19. For this process, Tucker discloses a kernel filter having shaded weights ("weighting masks" at column 9, line 34; "two dimensional low pass filter with noise cleaning properties" at column 9, line 43).

It would have been obvious at the time the invention was made to one of ordinary skill in the art to utilize the kernel filter with shaded weights as taught by Tucker, to filter and smooth the edges in the images of Meagher, and thereby provide a smoothed and cleaner version of the images whereby "the remaining extraneous noise and less significant visual features … can be discarded" (Tucker, column 2, line 19) while at the same time providing "noise cleaning properties" (Tucker, column 9, line 43).

38. Claim 169, as well as its corresponding dependent claims, are rejected under 35 U.S.C. 103(a) as being unpatentable over the combination of by Meagher (US 4,694,404 A) and Cleminson (US 4,675,829 A).

Notes:

- Intended use limitations in the body of the claim are not given weight.
- The details of Meagher as described above are incorporated herein by reference, and will not be repeated here.

Meagher does not teach generating artificial intelligence information.

Cleminson states, at column 1, lines 10-34:

"Artificial intelligence (AI) technology is a discipline with an ultimate goal of providing a machine that is capable of reasoning, making inferences and following rules in a manner believed to model the human mind. A great deal of theoretical work has been done in this discipline, and much remains to be done. Artificial intelligence theory is beginning to find applications because of the hope that its principles can be effectively applied to develop better computer software and to provide to relatively untrained users sophisticated computer power to solve practical problems such as to assist in the analysis of massive amounts of relatively unprocessed data to aid in decision-making processes.

As AI technology begins to demonstrate potential and practical uses, tools are needed to speed development of practical computational systems. AI specialists have developed a number of AI-dedicated computer languages to assist in this development. Among the languages are LISP and PROLOG. However, these languages are not particularly easy for either skilled AI researchers or minimally-trained user/programmers to use to develop sophisticated and complex knowledge bases necessary to solve the problems related to artificial intelligence applications.

Hence, tools are needed which are better suited to the requirements of both a minimally-trained knowledge base user and a skilled AI researcher."

It would have been obvious at the time the invention was made to one of ordinary skill in the art to utilize the artificial intelligence processing as described by Cleminson above, either in the software and/or hardware of Meagher's various processing modules, in order to:

provide "a machine that is capable of reasoning, making inferences and following rules in a manner believed to model the human mind", and

"to develop better computer software and to provide to relatively untrained users sophisticated computer power to solve practical problems such as to assist in the analysis of massive amounts of relatively unprocessed data to aid in decision-making processes",

Thereby improving the speed and accuracy with which Meagher's processing modules make their respective decisions.

Response to Arguments

39. Applicant's arguments filed on July 22, 2004 have been fully considered but they are not persuasive.

The arguments are presented in the following sections:

I. USC 112 –1 REJECTIONS

II. TRAVERSE OF 37 CFR 1.83 AND 37 CFR 1.75 OBJECTIONS

III. THE EXAMINER HAS FAILED TO PROVIDE THE REQUIRED "SUBSTANTIAL EVIDENCE" AND HAS FAILED TO ESTABLISH A PRIMA FACIE CASE TO COUNTER THE APPELLANT'S ENTITLEMENT TO A PATENT

IV. ART REJECTIONS

V. COMMENTS ON AMENDMENTS TO THE CLAIMS

VI. AMENDMENTS

Each section is addressed below.

Section I provides a description of the specification layout and format, and summarizes numerous case law. The applicant appears to be arguing that a "self-contained embodiment" is disclosed; and he appears to be relying upon "obviousness". The arguments are generalized in nature. However, in response to those arguments, the examiner has even further clarified his position regarding written description in the written description section above. This clarification does not represent a shift in position, nor does it represent a new grounds of rejection.

With one exception, section I section fails to address the rejections of any specific claims. Regarding the exception, sub-section 1.8 attempts to show written description support for the example claim by pointing to specific sections and figures of the original disclosure. These arguments are not convincing for at least the reasons described in the written description rejections above. For example, the specification does not describe a coherent embodiment or a partial embodiment with links or guides to other suggestions in the specification that would lead one to generate GPS navigation information and radar information, and then to generate data compressed image information and load database information in response to the radar information.

In conclusion, the applicant has mapped the individual claim elements to specific figures and to the specific pages of the specification. However, upon close examination of this mapping, the examiner is unable to find a coherent embodiment, or cohesive suggestions or guides that link the disparately disclosed elements of the specification together in the manner claimed (i.e., including the clamed interrelations between the elements). The examiner was unable to locate any guides whatsoever in the specification that would lead a path to the disparate elements and descriptions in the specification to achieve the claimed invention; without foreknowledge of the claim itself and without a lot of "obviousness". In the absence of such a showing, the written description rejections are maintained. That is, given the claim itself as a guide, it may (or may not) have been obvious to interconnect the disparately disclosed elements to achieve the claimed results. However, this is not the criteria upon which the written description requirement is based, as explained above. ***The question is whether or not the applicant invented the claimed subject, or whether the original disclosure anticipated the claimed subject matter, BEFORE the claim was drafted***. In this case, it is the examiner's contention that the answer is no.

In section II, the applicant argues that the specification and drawing objections are improper. The examiner disagrees. However, these objections have been withdrawn in favor of the statutory rejections advanced herein.

In section III, the applicant argues that the examiner has failed to meet the "substantial evidence" standard. In response, it is noted that "substantial evidence" is the standard adopted by the Federal Circuit for reviewing factfinding by the Board of Patent Appeals and

Interferences. It is unclear how the applicant expects this standard to apply to the examiner, as the examiner does not review the BPAI. However, the examiner maintains that each of the above rejections have been properly advanced in accordance with the relevant law, rules and PTO policies.

In section IV, the applicant traverses the art rejections. This section appears to be a generalized discussion of case law, without relating that case law to a single claim or a single ground of rejection. No response is merited.

Sections V and VI do not present arguments.

Conclusion

40. Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event,

however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

41. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Brian P. Werner whose telephone number is 703-306-3037. The examiner can normally be reached on M-F, 8:00 - 4:30.

If attempts to reach the examiner by telephone are unsuccessful; the examiner's supervisor, Leo H. Boudreau can be reached on 703-305-4706. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

Brian Werner
Primary Examiner
Art Unit 2621
October 27, 2004

BRIAN WERNER
PRIMARY EXAMINER